ALBERTA WETLAND INVENTORY STANDARDS VERSION 2.0

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1.0 INTRODUCTION

This report represents a supplemental update to the Alberta Wetland Inventory (AWI) Standards Version 1.0 that was developed by Vitt et al. (1996). While the classification system remains the same as the initial version, this report provides additional information that will allow for:

- Verification of wetland type identified from aerial photography by field-based investigations conducted as part of the Alberta Peat Task Force (Appendix 1, 2, and 3)
- Alignment of ecosite phase classification of Beckingham and Archibald (1996) with AWI
- Recommended coding form (Appendix 4)

The classification scheme used for this report follows the classes developed by the National Wetlands Working Group (1988), with subclasses recognized on the basis of vegetation and landform type at both the wetland complex and more local wetland element level. The Alberta Wetland Inventory Classification contains four levels that include 1) wetland class (National Wetlands Working Group 1988); 2) vegetation modifier; 3) wetland complex landform modifier; and 4) local landform/vegetation modifier. Of the possible combinations that can occur, 15 wetland types are common in Alberta (Vitt et al. 1996), though other wetland types can and do occur.

As AWI is based on gross characteristics of vegetation visible from aerial photographs, the general structure of vegetation is different between AWI types (Vitt et al. 1996). However, the details of plant communities that make up this general vegetation can vary within an AWI class (Forest 2001). For each wetland type the architecture of how vegetation is structured vertically (layers) and spatially (microhabitats) will differ. Common plant species and community architecture will be discussed for each of the fifteen common wetland types. In addition, 106 sites examined for plant composition, layer, and microhabitat structure as part of the Alberta Peat Task Force (Appendices 1, 2, and 3) will be analysed by wetland type using canonical correspondence analyses (PCORD 1999). The objective of this exercise is to examine how vegetation and community structure compare and contrast within and between wetland types to aid users in field verification of AWI interpretation.

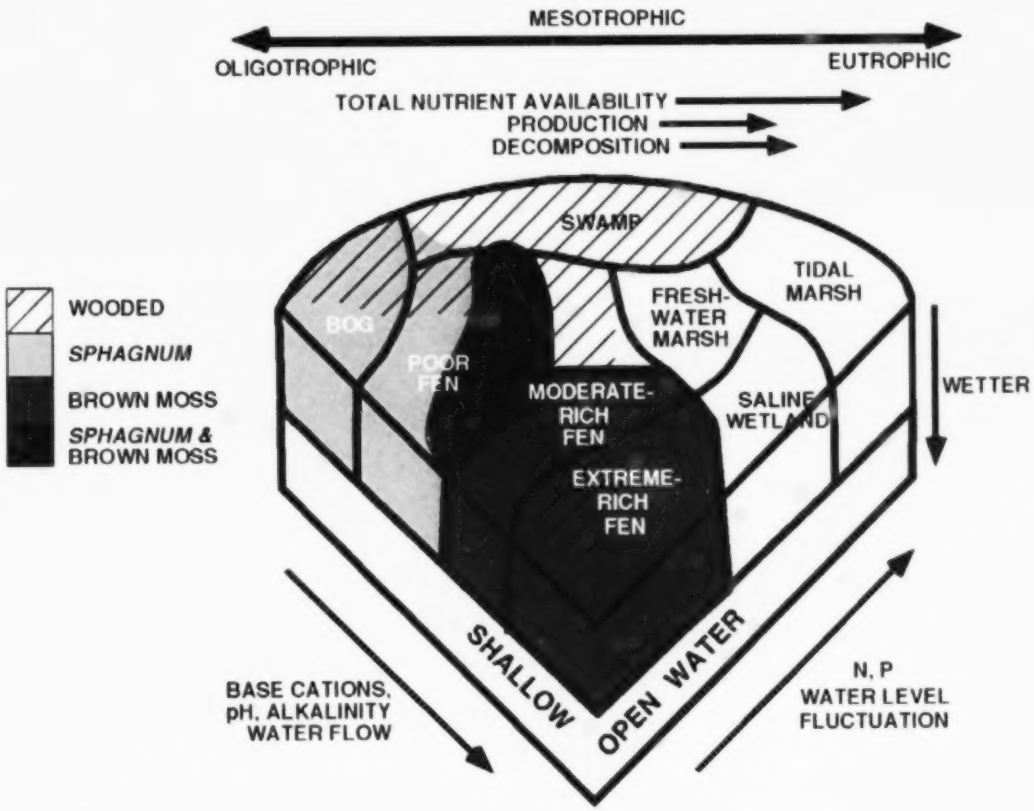
2.0 DEFINITION OF WETLANDS AND WETLAND CLASSES

In Canada wetlands have been defined as "...land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment" (National Wetlands Working Group 1988). The environmental processes that control wetland development form hydrologic, chemical, and biotic gradients and commonly have strong cross-correlations. These interrelated gradients are here divided into five nodes that define wetland classes used in this report, of which two are peatlands with > 40 cm of accumulated organics and three are non-peat forming wetlands generally having < 40 cm of accumulated organics. Peatlands are subdivided into 1) fen and 2) bog; whereas non-peat forming wetlands are subdivided as 1) shallow open water, 2) marsh, and 3) swamp (Figure 1). This primary wetland subdivision forms the foundation for defining Alberta wetlands and has been recognized by the Provincial Government within draft policy (Alberta Water Resources Commission 1993).

Peatlands differ from non-peat forming wetlands by a combination of interrelated hydrologic, chemical, and biotic factors that results in a decrease in decomposition relative to plant production allowing for the accumulation of peat. The stabilization of seasonal water levels and restriction of water flow through a wetland allows for the establishment and development of a bryophyte layer. The stabilization of regional water tables appears to have been an important component in the successional change from prairie marshes to boreal fens in the western interior of Canada over the past 10,000 years (Zoltai and Vitt 1990).

The establishment of a bryophyte layer results in the accumulation and maintenance of nutrients in a nonavailable form, reducing vascular plant production. Stabilized water levels, anaerobic conditions, and decreased nutrient availability lead to a substantial decrease in decomposition rates, that results in the development of peat accumulating ecosystems (Vitt and Kuhry 1992). Biotic (*Sphagnum* presence) and chemical (decomposition) processes lead to acidification and oligotrophication. Alberta peatlands are classified into geogenous fens and ombrogenous bogs, each with distinctive indicator species, acidity, alkalinity, and base cation content (Figure 1).

FIGURE 1. Ternary diagram of wetland classes and their relationship to chemical and biotic gradients (Modified from Vitt 1994).



Fens are geogenous ecosystems that are affected by mineral soil waters (ground and/or surface) that may be relatively rich in mineral elements. Fens can be subdivided on the basis of hydrology into: soligenous and largely influenced by flowing surface water; topogenous and largely influenced by stagnant ground water; or limnogeneous and largely influenced by associated lakes and ponds. All three fen types have water levels at or near the peat surface. Soligenous fens commonly have discrete patterns of open pools (flarks) alternating with elongate, shrubby to wooded ridges (strings) oriented perpendicular to the direction of surface water flow. These patterned fens may be either acidic or basic. Topogenous, limnogenous, and some soligenous fens are nonpatterned. Fens can be open and dominated by *Carex*, *Scirpus*, and *Eriophorum*; shrubby and dominated by *Betula* and *Salix*; or wooded to forested dominated by some combination of *Picea mariana*, *Larix laricina*, *Betula*, and *Salix*.

Originally based on criteria derived from vegetation, fens have in the past been subdivided on the basis of the number of indicator species. Poor fens are low in indicator species, while extreme-rich fens are high in indicator species; moderate-rich fens are intermediate. This gradient of indicator species correlates with a chemical gradient (Sjörs 1952). Poor fens are acid (pH 4.5-5.5), poor in base cations and have no or little alkalinity. They are dominated by oligotrophic and mesotrophic species of *Sphagnum*. Moderate-rich fens have slightly acid to neutral pH (5.5-7.0) and have low to moderate alkalinity with a ground layer of brown mosses namely: *Drepanocladus*, *Brachythecium*, *Calliergonella*, and low abundances of mesotrophic species of *Sphagnum*. Extreme-rich fens have basic pH (above 7.0), high concentrations of base cations, and high alkalinity. They are characterized by species of *Drepanocladus*, *Scorpidium*, and *Campylium* and may contain marl deposits.

Bogs are ombrogenous peatlands that receive their water only from precipitation and have low water flow. The water table is generally 40-60 cm below the peat surface. For these reasons bogs are acidic ecosystems with pH below 4.5; they are poor in base cations, and have no alkalinity. Bogs are dominated by oligotrophic species of *Sphagnum*, feather mosses: *Pleurozium schreberi* and *Hylocomium splendens*, and lichens of *Cladonia* and *Cladina*. They may be open, wooded or forested with trees limited to *Picea mariana*. As a result of the low thermal conductivity of dry *Sphagnum*, bogs have lower surface water temperatures then other surrounding organic and nonorganic soils. Regional permafrost is

consequently restricted to bogs at its southern limit, where it forms peat plateaus and palsas (Vitt et al. 1994).

Marshes are open, non-peat forming wetlands that are dominated by sedges (Cyperaceae) and other monocots. Marshes are characterized by seasonal water level fluctuations, relatively high amounts of water flow, and are influenced by ground and surface waters. As a result, concentrations of nitrogen and phosphorus are high, leading to abundant vascular plant production; however, peat accumulation is limited by high decomposition rates. Bryophytes are generally lacking or not abundant as they do not compete well with rapid vascular plant growth and do not tolerate large fluctuations in seasonal water levels. As with shallow open waters, chemical differences in marshes strongly influence their floristic composition. Alkaline marshes (dominated by calcium and bicarbonate) are dominated by *Carex*, *Scirpus*, and *Typha* whereas saline marshes (dominated by sodium and sulfate) are largely occupied by *Salicornia* and *Scirpus*.

Swamps are forested, wooded or shrubby non-peaty wetlands. Swamps and marshes have a poorly developed bryophyte layer that results from strong seasonal water level fluctuations and high vascular plant production. Peat accumulation is limited in swamps as decomposition rates are high. Vegetatively swamps are quite diverse and in Alberta may be composed of some combination of *Larix laricina*, *Picea mariana*, *Betula*, and *Salix*. Swamps can have a poor- to well-developed bryophyte layer but, different from peatlands, always have substantial areas of microhabitats that completely lack or have few bryophytes.

Shallow Open Waters are non-peat forming wetlands that are characterized by aquatic processes confined to less than 2 m depth at midsummer. These wetlands have submergent to floating vegetation and form a transition to truly aquatic ecosystems, and may represent more permanent ecosystems, or transitory system generated by flooding of land. The chemistry of this wetland class is variable and does not distinguish it from the remaining four wetland classes, and floristic composition is dependent on chemical conditions.

3.0 SUBDIVISION OF WETLAND CLASSES

Wetland types (bogs, fens swamps, marshes, and shallow open waters) are further subdivided into three subclasses on the basis of vegetation and landform criteria at the wetland complex and more local wetland element scale (Table 1). The second subdivision of AWI is a forest cover classification, with three possible levels-forested>70% tree cover; wooded >6 to $\leq$ 70% tree cover; and open $\leq$ 6% tree cover. By definition not all five classes can be placed into all three subdivisions. While bogs, fens, and swamps may be forested, wooded, or open; marshes and shallow open waters may only be open as wooded to forested non-peat accumulating wetlands are always classified as swamps.

The third subdivision of AWI is a wetland complex landform modifier that recognizes the presence of patterning and permafrost (Table 1). In Alberta patterning is restricted to fens, whereas regional permafrost is almost exclusively restricted to bogs. For this reason all non-peat accumulating wetlands will always have a third subdivision classification of N. Bogs may be X or N but never P, and fens may be P or N but never X.

The fourth subdivision of AWI is a local wetland element landform or vegetation modifier (Table 1). Open wetlands may be given a subclass modifier recognizing shrubby or graminoid vegetation, while forested to wooded peatland classes may receive permafrost related local modifiers of C, R, I, or N. Wooded to forested non-peat accumulating wetlands are restricted to a fourth subdivision modifier of N as local permafrost is almost exclusively restricted to peatlands in Alberta.

While vegetation of individual wetland types can be similar (Forest 2000), the architecture of how various plant communities and microhabitats are spatially structured across the wetland landscape differs between each wetland type. Hence, different wetland types identified from aerial photography have characteristic vegetative architecture that can be utilized to verify wetland types interpreted from aerial photos.

TABLE 1: Wetland classification scheme

WETLAND CLASS	Bog	B
	Fen	F
	Swamp	S
	Marsh	M
	Shallow Open Water	W
	Non-wetland	Z
VEGETATION MODIFIER	Forested: closed canopy >70% tree coverage	F
	Wooded: open canopy >6-70% tree coverage	T
	Open: shrubs, sedges, graminoids, herbs, etc. ≤ 6% tree cover	O
WETLAND COMPLEX	Permafrost is present	X
LANDFORM MODIFIER	Patterning is present	P
	Permafrost or patterning is not present	N
LOCAL LANDFORM MODIFIER	Collapse scar	C
	Internal lawn with islands of forested peat plateau	R
	Internal lawns	I
	No internal lawns are present	N
	Shrub cover > 25% when tree cover ≤ 6%	S
	Graminoid dominated with shrub cover ≤25% and tree cover ≤6%	G

4.0 WETLAND ARCHITECTURE: VEGETATION LAYERS AND MICROHABITATS

Wetland architecture is here defined as the characteristic physiognomy (vegetation layer organization) and microhabitats present in a wetland. Vegetation layers are the vertical structure present within a wetland type, while microhabitats represent an environment that has a unique set of ecological conditions within a wetland.

Wetland sites examined as part of the Alberta Peat Task Force were evaluated for vegetation cover in relation to the architectural distribution of each layer and microhabitat present (Appendix 2 and 3). Vegetation layers were subdivided vertically into the overstory, understory, and groundcover with further subdivision in each based on vertical height and vegetation type. The overstory was subdivided into four sublayers that included 1) tree cover > 10m; 2) tree/shrub cover of 2 – 10m; 3) tree/shrub cover of 0.5 to 2m; and 4) tree/shrub cover of <0.5m. The understory was subdivided into herb and graminoid cover while the ground layer was subdivided into seven components: 1) bryophytes; 2) lichens; 3) bare peat (no living vegetation present); 4) coarse woody debris; 5) rocks; 6) aquatic vascular plants; and 7) open water. In addition, the number of snags were counted.

In contrast, wetland microhabitats were structured into substrate type and relative position to the water table. Nineteen wetland microhabitats were recognized that included ten associated with specific substrates: 1) tree stumps; 2) tree trunks; 3) tree bases; 4) logs; 5) shrub bases; 6) grass tussocks; 7) dung/skeletons; 8) small lawns (small uniform area with little microtopography); 9) root mounds; and 10) bare peat (apparently non-living ground cover). An additional nine microhabitats were recognized along a moisture gradient that included from driest to wettest: 11) peat plateau surface (elevated peat surface underlain by permafrost); 12) string (linear raised area trending perpendicular to surface water flow); 13) hummocks (top of elevated mound); 14) hummock sides (side of elevated mound); 15) hollows (intervening areas between hummocks above water table); 16) lawns (large uniform area with little microtopography); 17) carpets (uniform area with water table closer to the peat surface than in lawn areas, peat is often a floating mat); 18) wet holes (small <50 cm diameter, deep depressions that extend below the water table); and 19) pools (large > 50 cm diameter, deep depressions that extend below the water table).

Not all wetland types will have all vegetation layers and microhabitats. However, some wetland types will have a distinctive suite or affinity for certain layers and microhabitats. Distinctness and/or preference of different wetland types for these architectural elements are evident in a Canonical Correspondence Analyses (CCA) of wetland vegetation (Figures 2 and 3). Several of the different wetland types identified from aerial photo interpretation cluster into regions of the CCA, though overlap between some types does occur. As the CCA ordinates sites along layer or microhabitat variation, wetland type location on the CCA reflects preference for those layers and microhabitats, while the degree of isolation marks the degree of distinctness.

FIGURE 2. Canonical correspondence analysis of plant community data from 105 wetland sites by layer examined as part of the Alberta Peat Task Force (Appendix 2 and 3). Location of each layer is shown on the CCA with individual wetland sites designated by type with symbols. The AWI class of each site is shown by symbols. Sites have affinities for layers they are closest to on the ordination. Distribution of sites on the first two axes represents 49.7% of the variance in the data set.

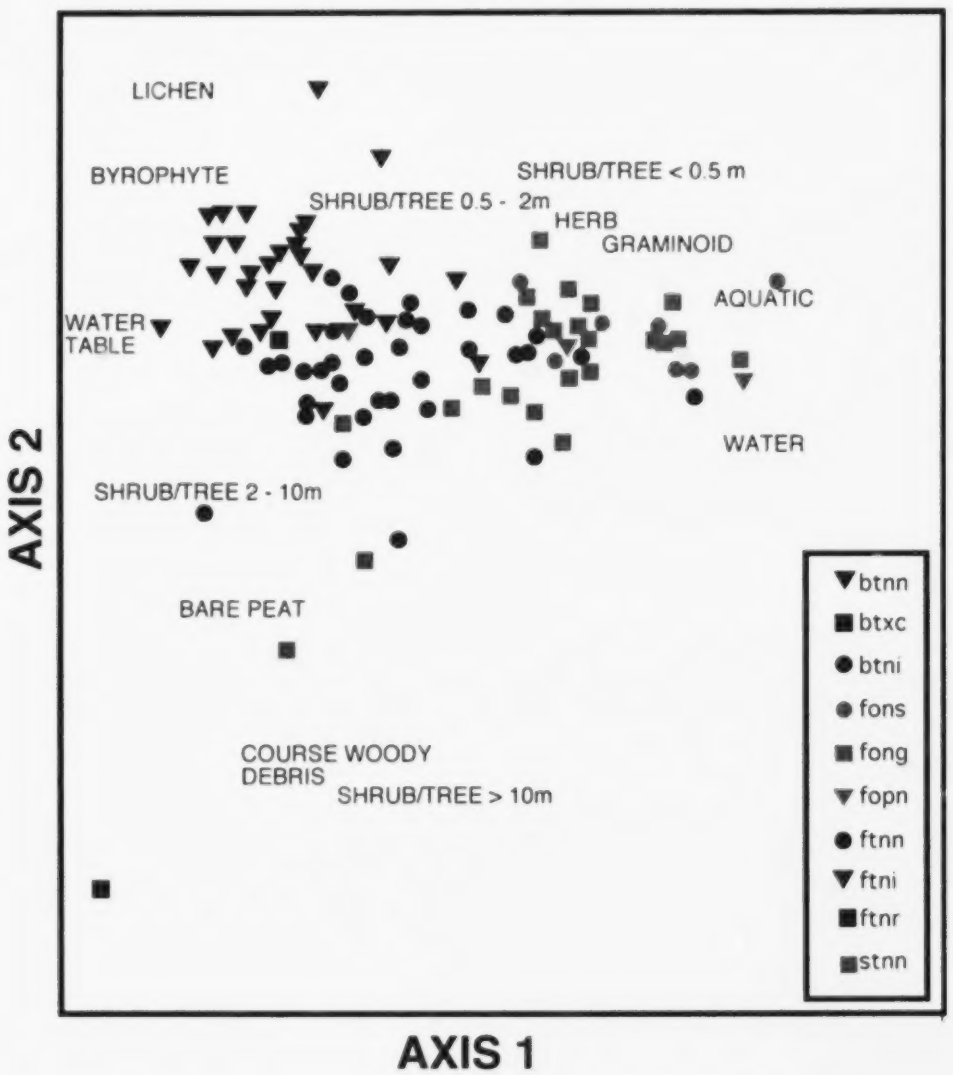
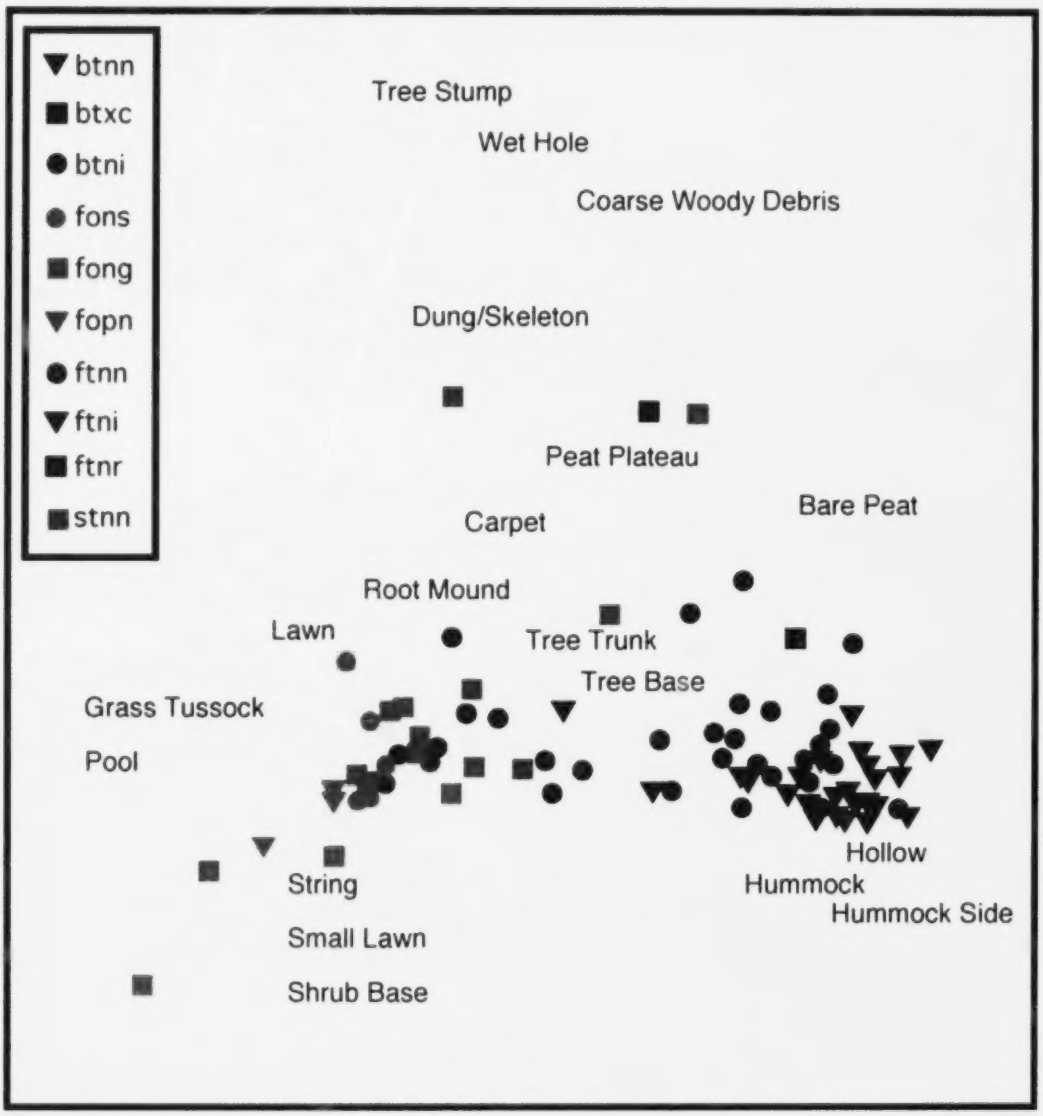


FIGURE 3: Canonical correspondence analysis of plant community data from 105 wetland sites by microhabitat examined as part of the Alberta Peat Task Force. Location of each microhabitat is shown on the CCA with individual wetland sites designated by type with symbols. Sites have affinities for microhabitats they are closest to the on the ordination. Distribution of sites on the first two axes represents 49.7% of the variance in the data set.



5.0 LINKAGE OF AERIAL PHOTOGRAPH INTERPRETATION AND FIELD BASED STUDIES

Bogs

Bogs develop in areas of restricted surface water flow and are found along drainage divides, in stagnation zones of peatland complexes created in the lee of surface water flow obstructions, and in small, isolated basins. Bogs are subdivided into forms based on forest cover, with open bogs having ≤ 6% cover (excluding areas that have recently burned), wooded bogs having > 6 to 70% cover, and forested bogs having >70% cover. In continental western Canada, bogs are forested exclusively with *Picea mariana* (Vitt et al. 1994). The presence of permafrost and internal lawns is also used in subdividing bogs following Vitt et al. (1994). Following these criteria, five bog forms can be recognized in Alberta.

Veneer bogs with or without collapse scars (**Boxc** and **Boxn**)

Aerial Photo Interpretation

Veneer bogs are characterized by a thin layer of peat generally 0.4 – 1.5 m. They contain permafrost and overlie gently sloping terrain. Veneer bogs have a scanty tree cover (generally ≤ 6%) and may contain circular to irregularly shaped collapse scars that have a sharp boundary with the surrounding bog. On aerial photographs, veneer bogs are recognized by a light tone and a rough texture generated by the high reflectance of patchy lichen ground cover (Figure 4). They can be associated with circular collapse scars that have an even lighter and brighter tone. Unlike other peatlands in Alberta, veneer bogs may be found on low angle slopes grading into wooded, permafrost dominated bogs (peat plateaus) in areas where the surface expression is level. When found on low angle slopes, veneer bogs are associated with medium toned, parallel runnels oriented downslope representing drainage areas that are wooded with *Picea mariana* and *Larix laricina* (Figure 5).

Vegetation

Ground cover on the veneer bog is dominated by feathermosses such as *Hylocomium splendens* and *Pleurozium schreberi*, interspersed with hummocks of *Sphagnum fuscum*. Lichens of *Cladonia*, *Cetraria*, and *Cladina* are also common. Collapse scars are located approximately 100 cm below the bog surface and have a ground cover dominated by *Carex* and wet species of *Sphagnum*. While topography

associated with runnels and interrunnel areas can be poorly expressed, changes in tree density and height (denser and taller within runnels) allows for their recognition on the ground, in addition to the presence of other species not typically found within bogs (i.e. *Betula papyrifera, Cornus canadensis,* and *Frageria vesca* (Zoltai et al. 1988)). No sites examined as part of the Alberta Peat Task Force were located within veneer bogs, as they are generally restricted in occurrence to Alberta's northernmost uplands (Vitt et al. 1996). Though the vegetation of veneer bogs is not different from other bog types, particularly other permafrost bog types, the occurrence of this wetland on slopes and the characteristic architecture of runnel and interrunnel areas is unique to wetlands within continental western Canada.

Wooded to forested permafrost bogs (peat plateaus) with or without collapse scars (**Btxc**, **Bfxc**, **Btxn**, and **Bfxn**)

Aerial Photo Interpretation

Wooded to forested permafrost bogs are wetlands that contain perennially frozen peats. As such, wooded to forested permafrost bogs are similar to veneer bogs, however unlike veneer bogs they only occur on level surfaces. They have a relatively flat, raised surface, that is elevated above the surrounding wetland by 1 – 2 m, and can vary from small, isolated islands within larger wetland complexes, or as complex networks of large, coalescing plateaus within a discontinuous, interconnected matrix of nonpermafrost fen. Tree heights on wooded to forested permafrost bogs are generally more uniform than on veneer bogs as the lack of runnels does not promote increased tree growth. In addition, as the name implies wooded to forested permafrost bogs can support a higher density of tree growth. Aerial photo recognition of wooded to forested permafrost bogs is based on a dark tone, and a smooth, "velvety" texture (Figure 6). Small, circular, light toned areas (representing collapse scars) within a matrix of *Picea mariana* forest are diagnostic of this wetland form (Figure 7). Unlike other wooded bog wetland forms, wooded to forested permafrost bogs can have margins with acute angles while nonpermafrost bogs tend to have rounded margins.

Vegetation

Wooded to forested permafrost bogs are found in increasing frequency north of the Lower Foothills and the southern extension of the Dry Mixedwood Subregion (Vitt et al. 1994). They are typically more

heavily forested at the southern limit of their occurrence within the Central Mixedwood Subregion, with crown closure decreasing as mean annual temperature decreases. The amount of bare surface peat (apparently non-living ground cover) increases as crown closure increases, with presence of bare peat one of the ubiquitous microhabitats. While vegetation can be similar between permafrost and nonpermafrost bogs on the bog proper (Belland and Vitt 1995), permafrost bogs tend to have a greater proportion of bare peat and higher lichen cover (Belland and Vitt 1995). Differences in microhabitat distribution and associated vegetative differences between permafrost and nonpermafrost bogs are a function of the relative position of the water table (57 $\pm$ 24 cm and 35 $\pm$ 15 cm below the surface for permafrost and nonpermafrost bogs respectively [Appendix 2]), in addition to shade (Belland and Vitt 1995). As mentioned above, permafrost bogs are more heavily wooded at their southern limit (Central Mixed Wood Subregion), with dense tree cover associated with tall *Picea mariana*. Here, the close association of dense forest cover and bare peat is evident as frequent squirrel middens and/or dense coniferous litter.

Data collected as part of the Alberta Peat Task Force (Appendix 2 and 3) show permafrost bogs have a cover of 20% and 60% for >10 m and 2 – 10 m tree heights respectively. In comparison, nonpermafrost bogs had a mean cover of 0.2% and 28% for >10 m and 2 – 10 m tree heights respectively. The distinctness of wooded permafrost bog wetland types can be seen by their separation in a CCA diagram of wetland type and vegetation layers, where wooded permafrost bog sites (BTXC) are isolated from all other wetland types (Figure 2). Isolation is a function of not only low water table but also of high cover values for tall ee (> 10 m) and bare peat surfaces.

As with other bog types, tree cover on wooded permafrost bogs are almost exclusively restricted to *Picea mariana*, though *Betula papyrifera* can be present, and commonly establishes after fire. Vascular plant species composition and structure are also similar to other bogs types. The shrub layer is dominated by *Ledum groenlandicum*, with lesser numbers of *Alnus rugosa, Chamaedaphne calyculata, Kalmia polifolia, Rubus chamaemorus*, and occasional clumps of *Salix* spp. The herb layer commonly includes *Carex* spp., *Eriophorum* spp., *Smilacina trifolia*, and *Vaccinium vitis-idaea*. Ground cover in permafrost bogs is

dominated by lichens (mostly species of *Cladina*, *Cetraria* and *Cladonia*), and can be interspersed with *Pleurozium schreberi*, *Sphagnum fuscum*, and *Polytrichum strictum* along the peat plateau surface.

Wooded to forested, permafrost bog collapse scars are typically 100 cm lower than the surrounding bog surface and may be present as isolated, circular areas or as interconnected, elongate drainage channels. Vegetation within collapse scars is dominated by *Carex* spp. and a general lack of tree and shrub cover (Figure 8) with an extensive groundcover layer that is almost exclusively *Sphagnum*, with species including *Sphagnum angustifolium*, *S. jensenii*, *S. majus*, *S. obtusum*, and *S. riparium*. Often collapse scars have dead, dying, or leaning trees present on one or more sides, typifying the concept of "drunken forest" (Figure 8). Wooded to forested, permafrost bogs with collapse scars are often referred to as peat plateaus with collapse scars (Zoltai 1971, National Wetlands Working Group 1988). The presence of collapse scars and associated microhabitats (carpets and lawns) shift the location of this wetland type on the microhabitat ordination (Figure 3), hence for microhabitat cover wooded permafrost bogs are not isolated from other forested wetland types.

Wooded bogs without internal lawns (**Btnn**)

Aerial photo interpretation

Wooded bogs without internal lawns have a flat, homogenous surface that is uniformly wooded. Bogs without internal lawns occur as islands within large complex fens or as peninsulas protruding into large fens. Bogs can also be found confined to small basins associated with hummocky terrain or in broad, poorly defined depressions as well as along drainage divides. On aerial photographs, wooded bogs without internal lawns are recognized by a medium to dark tone and a smooth, "velvety" texture (Figure 9). Their is no evidence of surface water movement as there is in wooded fens and unlike coniferous swamps, they are not found in areas of fluctuating water levels such as along stream courses, though they may occur adjacent to small isolated, circular to scallop-shaped lakes (Figure 9). Wooded bogs are distinguished from stands of *Picea mariana* occurring on uplands by their smooth, level surface, and relatively low tree height. Unlike wooded permafrost bogs, they contain only seasonal ice, are only elevated from surrounding fens by 40 cm, and do not contain collapse scars.

Vegetation

As with permafrost bogs, nonpermafrost bogs have a characteristic landscape architecture that is dominated by hummocks and hollows in addition to microhabitats associated with trees (fallen logs, tree bases, snags etc.). Carpets and lawns, that are typical of collapse scars and internal lawns are not present in nonpermafrost bogs without internal lawns. The distinctive architecture of wooded nonpermafrost bogs without internal lawns is reflected in its separation from other wetland types in both the layer (Figure 2) and microhabitat (Figure 3) ordinations, where only wooded nonpermafrost fen overlap slightly.

Nonpermafrost bogs without internal lawns have a tree cover that is almost exclusively restricted to *Picea mariana* (Figure 10). Vascular plant species are also similar to other bogs types. The shrub layer is dominated by *Ledum groenlandicum*, with lower numbers of *Chamaedaphne calyculata*, *Kalmia polifolia*, and *Rubus chamaemorus*. Unlike permafrost bogs, shrubs of *Alnus rugosa* and *Salix* spp. and *Carex spp.* are virtually absent. *Eriophorum* spp., *Drosera* spp.and *Smilacina trifolia* as well as the shrubs *Vaccinium oxycoccus* and *V. vitis-idaea* are common. Ground cover in nonpermafrost bogs is dominated by *Sphagnum*: *S. fuscum, S. magellanicum, and S. angustifolium*, brown mosses (*Aulacomnium palustre, Dicranum spp.* and *Mylia anomala)* feather mosses (*Hylocomium splendens, Pleurozium schreberi*, and *Ptilium crista-castrensis*) and lichens (mostly species of *Cladina, Cetraria* and *Cladonia*), within a hummock and hollow architecture. The dominance of *Sphagnum* cover and lower amounts of lichens and other mosses is reflected in the separation of this wetland type in the CCA ordination diagram from permafrost bogs as well as wetter wooded fens (Figure 3).

Wooded bogs with forested permafrost bog and internal lawns (**Btnr**)

Aerial photo interpretation

Wooded bogs with forested permafrost bog and internal lawns are characterized by a heterogeneous surface that is dominated by wooded bog with a ground cover of *Sphagnum fuscum* and lichens, interspersed with densely forested bog having a scant ground cover dominated by feather mosses. Areas of densely forested bog are elevated above the surrounding wooded bog by > 40 cm, representing areas of relict permafrost and often are found in radiating patterns emanating from the bog crest. These

areas have been termed frost mounds (Beilman et al. 2001). Associated with areas of dense black spruce crown closure are open, wet, internal lawns dominated by *Sphagnum* and *Carex* containing dead trees. Internal lawns are generally 40 - 60 cm lower than the surrounding wooded, nonpermafrost bog and are irregular in shape. These internal lawns differ from those previously mentioned due to the presence of standing dead trees as well as their smaller maximum elevational differences to the surrounding bog.

Stratigraphic analyses of bogs with internal lawns from Alberta reveal an uppermost layer of about 30-50 cm of wet, oligotrophic species of *Sphagnum*, underlain by a thin layer of sedges followed by a layer dominated by *Polytrichum strictum* or *Pleurozium schreberi*, and abundant wood and/or black spruce needles. Beneath this last layer is a thick layer of a variety of more decomposed macrofossils, all indicating a habitat of dry wooded bog suggesting that substantial change occurred from a relatively dry, wooded bog habitat to a wet open lawn without transitional phases. Such changes are consistent with thermal subsidence of permafrost peatlands and the distribution of landforms comprising this wetland form (Vitt et al. 1994).

Wooded bogs with forested permafrost bog and internal lawns are recognized on aerial photos as medium toned wetlands without evidence of surface water movement. These bogs generally occur as islands or peninsulas within large, complex peatlands and have smooth, rounded margins. A "blotchy" pattern of distinctly darker and "fuzzy" lighter tones is present (Figure 11), representing permafrost bog and internal lawns respectively. Internal lawns are located within a nonpermafrost bog matrix, whereas collapse scars are surrounded by a matrix of peat plateau.

Vegetation

Wooded nonpermafrost bogs with forested permafrost bog and internal lawns represent a wetland type with a complex architecture of microhabitats. The nonpermafrost bog component is identical in its wetland architecture to wooded nonpermafrost bogs without internal lawns, while the forested permafrost bog component have a similar architecture to wooded permafrost bogs. In addition, the presence of internal lawns is reflected in the occurrence of lawn and carpet microhabitats that are typically absent in wooded nonpermafrost bogs without internal lawns.

As with layers and microhabitat covers, vegetation present within wooded nonpermafrost bogs with forested permafrost bog and internal lawns is complex. Vegetation of the nonpermafrost bog component is identical to that present in nonpermafrost bogs without internal lawns. Tree cover is almost exclusively restricted to *Picea mariana*, and vascular plant species are also similar to other bogs types. The shrub layer is dominated by *Ledum groenlandicum*, with *Chamaedaphne calyculata*, *Kalmia polifolia*, and *Rubus chamaemorus* present at lower cover values. Unlike permafrost bogs, sedges and shrubs of *Alnus rugosa* and *Salix* spp. are virtually absent. Herbs commonly include *Drosera* spp., *Eriophorum* spp., *Smilacina trifolia*, as well as *Vaccinium oxycoccus* and *Vaccinium vitis-idaea*. Ground cover in nonpermafrost bogs is dominated by *Sphagnum*: *S. fuscum, S. magellanicum, and S. angustifolium* in addition to brown mosses (*Aulacomnium palustre, Dicranum spp.* and *Mylia anomala)* and feather mosses (*Hylocomium splendens, Pleurozium schreberi*, and *Ptilium crista-castrensis*) as well as lichens (mostly species of *Cladina, Cetraria* and *Cladonia*), within a hummock and hollow architecture. In addition to these species, local areas of permafrost bog typified by tall, dense trees and a high percentage of bare peat/lichen and feathermoss communities are present as are local areas of internal lawn with carpets and lawns of *Carex* spp. and *Sphagnum*, typically *S. angustifolium, S. riparium*, and *S. russowii* with abundant snags (Beilman 2001). Forested permafrost bog and internal lawn areas are typically found adjacent to each other within the larger matrix of nonpermafrost bog. Pool microhabitat areas, representing wet areas where permafrost is actively melting are present at their interface with the nonpermafrost matrix. A typical wooded nonpermafrost bog with forested permafrost bog and internal lawns is shown in Figure 12.

Wooded bogs with internal lawns (**Btni**)

Aerial photo interpretation

This bog type is characterized by the presence of open, wet *Sphagnum-Carex*-dominated internal lawns, often containing partially buried stands of dead trees within a uniformly wooded bog island or peninsula. Internal lawns are 40 - 60 cm lower than the surrounding wooded bog surface and may occur in extensive, irregular patterns radiating from the bog island center, or in indistinct, nonradiating patterns. Although permafrost is absent, thin, seasonal frost layers can last well into late summer. Internal lawns

represent previous areas of permafrost that have historically degraded (Vitt et al. 1994, Halsey et al. 1995). Unlike wooded bogs with forested permafrost bogs and internal lawns, no areas of forested permafrost bog are present in this wetland type.

Wooded bogs with internal lawns are recognized on aerial photos as medium toned wetlands without any evidence of surface water movement (Figure 13). These bogs generally occur as islands or peninsulas within large, complex peatlands and have smooth, rounded margins. A "blotchy" pattern of "fuzzy" lighter tones is present within this wetland form representing islands of internal lawns.

Vegetation

Microhabitats and vegetation structure represent a transition between nonpermafrost bogs with forested permafrost bog (Btni) and internal lawns and nonpermafrost bogs without internal lawns (Btnn). The typical nonpermafrost bog hummock-hollow microhabitats are present, however unlike the Btnr wetland class there are no areas of permafrost bog, hence the taller trees and associated areas of bare peat and high lichen/feather moss cover are absent. Internal lawns with carpets and small lawns are present with vegetation typical of other internal lawns with *Carex* spp. and *Sphagnum* spp. dominate. In contrast to the Btnr wetland class, pools are generally absent as a permafrost component is not present as a meltwater source.

Fens

Vegetative patterns that result from the presence of surface water flow allow for the distinction of fens from bogs. Fens have been subdivided on the basis of: 1) presence of landforms (strings and flarks) oriented perpendicular to surface water flow direction(s) in a parallel or reticulate pattern; 2) forest cover with open fens having $\leq$ 6% cover, and wooded fens having > 6% cover of *Picea mariana* and/or *Larix laricina*; 3) presence of peat plateaus and internal lawns in wooded fens. Fen vegetation type can be subdivided into *Sphagnum*- and brown moss-dominated systems, each with distinctive vegetation communities that are partitioned in different spatial configurations across different wetland types.

Patterned fens (**Fopn** and **Ftpn**)

Aerial photo interpretation

Ribbed or patterned/string fens are a patterned form of geogenous peatland that are found in circumboreal and subarctic regions of the northern hemisphere (Troll 1944, Sjörs 1950; 1959; 1961, Ruuhijärvi 1960, Allington 1961, Heinselman 1963, Botch and Masing 1983, Zoltai et al. 1988, Vitt et al. 1996, Halsey et al. 1997). In addition, they have been reported in the arctic (Henoch 1960). Patterning is characterized by a string and flark (ridge and pool) pattern that runs parallel to surface elevation contours and perpendicular to the direction of water movement. Strings may span the entire fen in smooth or sinuous arcs that can subdivide and rejoin (Figures 11, 13, and 14). Pools, termed flarks by Andersson and Hesselman (1907) are found inbetween strings.

Unlike nonpatterned fens that are essentially level, ribbed fens have a slightly sloping surface of 0.1 to 1.0% (Zoltai et al. 1988). Detailed site studies in western Canada (Vitt et al. 1975, Zoltai et al. 1988) and elsewhere (Foster and King 1984, Seppälä and Koutaniemi 1985, Foster et al. 1988, Quinton and Roulet 1998, Charmann 1995), have shown that there is an elevational drop from flark to flark downslope. Strings tend to be closer together on steeper gradients and farther apart on shallower gradients. In addition, string orientation tends to become more sinuous and branching on lower slopes, with polygonal flark morphology—reticulate fens, typical of patterned fens with very low gradients (Zoltai et al. 1988).

Wetland inventories and methodologies conducted in Alberta (Zoltai et al. 1988, Vitt et al. 1996), recognize two basic types of patterned fens: wet patterned fens that have $\leq$ 6% tree cover on strings (Fopn); and dry patterned fens that do have> 6% tree cover on strings (Ftpn). As with other fen types in Alberta, patterned fens have a wide range of chemical properties with pH from about 4.2 to >7.0 as well as an associated wide-ranging vegetation (Vitt et al. 1975, Slack et al. 1980, Zoltai et al. 1988). While the majority of patterned fens in the province are rich (Vitt et al. 1996); poor, patterned fens are known to occur and are associated with acidic substrates (Vitt et al. 1975), as well as along drainage divides. Hence, there are potentially four types of patterned fens in Alberta: wet and poor; wet and rich; dry and poor; and dry and rich.

Vegetation

Patterned fen microhabitats are typified by alternating areas of strings and flarks (Figure 15). While overall vegetation communities can be similar to wooded and open fens, it is the architecture, i.e. spatial pattern of these microhabitats that are the distinguishing feature of this wetland class. Vegetation on flarks is different than that found on strings due to the position of the water table (Vitt et al. 1975, Slack et al. 1980, Glaser 1983, Foster and King 1984, Charmann 1993). In rich fens (pH >5.5) (Slack et al. 1980, Zoltai et al. 1988), flark vegetation is typically dominated by *Carex chordorrhiza, C. lasiocarpa, C. limosa,* with *Menyanthes trifoliata, Utricularia intermedia,* and *U. minor* also present. Mosses are typically *Campylium spp.* and *Scorpidium scorpioides,* as well as species of *Meesia triquetra* and *Drepanocladus* spp. String vegetation is comprised of the shrubs *Andromeda polifolia, Betula glandulosa, Ledum groenlandicum, Salix candida,* and *S. pedicellaris* with trees of *Larix laricina* and *Picea mariana* present on drier ridges. Mosses are typically dominated by *Aulacomnium palustre, Tomenthypnum nitens, Sphagnum angustifolium* and *Sphagnum warnstorfii,* with *Dicranum undulatum, S. fuscum,* and *Pleurozium schreberi* commonly found on drier strings. Vegetation in poor, patterned fens (pH 4.2 – 5.5) (Vitt et al. 1975, Zoltai et al. 1988) is dominated by *Carex limosa* and *Menyanthes trifoliata* as well as species of *Drepanocladus* and *Sphagnum* in flarks. String vegetation is similar to that of bogs (Vitt et al. 1975, Zoltai et al. 1988, Belland and Vitt 1995) and is typified by *Picea mariana, Ledum groenlandicum, Sphagnum fuscum,* and *S. magellanicum.*

While vegetation communities between these four patterned fen types differ, they are each not unique when compared to other open fen types on the basis of layer (Figure 2) and microhabitat (Figure 3) covers. For example a rich, nonpatterned treed fen can have similar species to a rich patterned fen with trees present on strings, however the architecture of the vegetation and microhabitats will be partitioned differently in space. Rich nonpatterned fens will contain hummocks and hollows that are distributed in an apparently random pattern over the fen surface. In contract, rich patterned fens with trees on the strings will have an ordered pattern of alternating flarks (with hollow vegetation) and strings (with hummock vegetation).

Nonpatterned, open, shrub-dominated fens (**Fons**)

Aerial photo interpretation

Nonpatterned, open, shrub-dominated fens can be recognized on aerial photographs by the presence of surface water movement and a lack of patterning (Figure 16). This fen type can be distinguished from other nonpatterned fen types by its medium gray tone that has a tendency to be "blotchy", reflecting the variation in shrub canopy closure, and on small-scale photos by the crenulate nature of the shrub cover. Nonpatterned, open, shrub-dominated fens can be poor or rich (Vitt and Chee 1990, Beckingham and Archibald 1996).

Vegetation

Nonpatterned, open, shrubby fens are lacking taller canopy layers, though they support shrubs of *Betula pumila*, and *Salix pedicillaris* as well as numerous other willow species (i.e. *S. candida*, *S. discolor*, *S. maccalliana*, *S. myrtillifolia*, *S. planifolia*, and *S. serissima*). Common graminoids, Carex, and herbs include *Calamagrostis canadensis*, *Carex aquatilis*, *Carex pauciflora*, *Calla palustris*, *Galium trifidum*, *Potentilla palustris*, *Smilacina trifolia*, and *Stellaria longifolia*. Bryophytes are dominated by *Sphagnum angustifolium* and *Tomenthypnum nitens*, with other *Sphagnum* spp. common in poor shrubby fens. In addition, *Aulacomnium palustre*, *Brachythecium* spp., and *Helodium blandowii* are common, although cover values are generally low.

Nonpatterned, open, shrubby fens are separated from wooded wetlands in the layer ordination (Figure 2) reflecting their dominance by low shrubs (< 2 m) and high graminoid covers. Wet microhabitats (lawns and carpets) are associated with Fons more than wooded wetlands and hence nonpatterned, open, shrubby fens are isolated from wooded wetlands on the microhabitat ordination (Figure 3). This wetland type is however not readily distinguishable on the basis of layer and/or microhabitat from nonpatterned, open graminoid-dominated and patterned fens as sites of these wetland types overlap (Figure 2 and 3).

Nonpatterned, open, graminoid-dominated fens (**Fong**)

Aerial photo interpretation

Nonpatterned, open, graminoid-dominated fens are characterized by the presence of a continuous *Carex* cover with ≤ 6% tree cover and < 25% shrub cover. Open, graminoid dominated fens can be distinguished from other nonpatterned fen types on airphotos by a light to very light gray tone with a smooth texture (Figures 16 and 17). This peatland type can grade into wet meadows associated with uplands and non-peat forming wetlands associated with aquatic ecosystems (marshes and shallow open waters). Non-peat forming wetlands are found in areas of fluctuating water level such as along the margins of lakes and streams, and generally lack a bryophyte layer and associated peat accumulation.

Vegetation

Open, graminoid-dominated poor fens occupy many places on the landscape. They can occur as collapse scars in association with peat plateaus and as laggs associated with bog islands. In addition they can occur in small isolated basins; and as flat, featureless fens that slope gently in the direction of drainage (Figure 18) and may be poor, moderate-rich, or extreme-rich (Vitt and Chee 1990, Nicholson and Gignac 1995). Occasional low shrub (< 25% cover can be found) and can include *Betula pumila, Chamaedaphne calyculata, Rubus acaulis, Salix myrtillifolia* and *Salix pedicellaris.* Sedges such as Carex aquatilis, C. diandra, and C. limosa in addition to the almost ubiquitous herb *Potentilla palustris* dominate the understory. Rich, open graminoid-dominated fens are dominated by a ground cover of *Aulacomnium palustre, Calliergon giganteum, Drepanocladus exannulatus,* and *Drepanocladus vernicosus,* while poor, open graminoid-dominated fens support a ground cover of *Sphagnum* that can include species: *S. angustifolium, S. centrale, S. fallax, S. jenseii, S. riparium, S. russowii, S. squarrosum, S. subsecundum,* and *S. teres.*

As with nonpatterned, open shrubby fens, open graminoid-dominated fens have a restricted number of vegetation layers, with graminoid and aquatic layers dominating (Figure 2). Microhabitats are also restricted as those associated with tree cover and tree derived substrates are generally absent. Lawns represent the largest microhabitat cover for nonpatterned, open graminoid-dominated fens, with grass tussocks and root mounds also being important (Figure 3). Nonpatterned, open graminoid fens are

however, not well distinguished from other open fen types (Fons and Fopn) as indicated by their overlap with sites of these wetland types on both the layer and microhabitat ordination diagrams (Figures 2 and 3).

Nonpatterned, wooded fens with no internal lawns (**Ftnn**)

Aerial photo interpretation

Nonpatterned, wooded fens with no internal lawns have >6% tree cover of some combination of *Picea mariana* and/or *Larix laricina*. An understory of shrubs of *Betula* and *Salix* is not uncommon. The ground cover of wooded fens can be *Sphagnum*- or brown moss- dominated. Wooded fens with no internal lawns have a smooth, homogenous surface that is medium gray in tone and has a "velvety" texture on aerial photos (Figure 17). The boundary between wooded fen and mineral upland can be difficult to distinguish and is determined on the basis of slope with wooded fens being found only on level surfaces. Tree density and height are also important factors in fen identification, and are a function of climatic and substrate conditions, hence should be locally derived.

Vegetation

Nonpatterned, wooded fens with no internal lawns occupy similar places on the landscape as open fens, and are often found in small isolated basins; and as flat, featureless fens that slope gently in the direction of drainage. They may be poor, moderate-rich, or extreme-rich (Vitt and Chee 1990, Nicholson and Gignac 1995), with each fen type having a distinctive vegetation community and associated water chemistry. Poor fens generally have a pH of <5.5, moderate-rich fens range between 5.5-7.0, while extreme-rich fens are generally > 7.0 (Vitt 1994). Vegetatively they fall between wooded bogs and open graminoid and shrubby fens (Figure 2), as they contain species common to both. Drier vegetation, common to bogs is represented by hummock species, while vegetation common to open fens occurs in wet hollows, carpets, lawns, and pools. As with vegetation, micro-habitats present in nonpatterned, wooded fens also fall between wooded bogs and open graminoid and shrubby fens (Figure 3), as aspects of both these wetland types occur in nonpatterned wooded fens.

The forest canopy in nonpatterned, wooded fen with no internal lawns consists of varying amounts of *Picea mariana* and/or *Larix laricina* along the poor to moderate-rich to extreme-rich gradient. In general, poor, wooded fens have a significant component of *Picea mariana*, generally ≥ 20%, with *Larix laricina* ubiquitously present, though in relatively low amounts (<20%) (Beckingham and Archibald 1996). In contrast, rich fens have a significant amount of *Larix laricina* (≥20%) and lower amounts of *Picea mariana* (Beckingham and Archibald 1996). Abboud et al. (2002) distinguished between moderate-rich and extreme-rich fens on the basis of tree cover. Extreme-rich fens are dominated by *Larix laricina*, while moderate-rich fens represented a mix of both species.

Occasional low shrub (< 25% cover can be found) and can include *Betula pumila, Rubus acaulis, Rubus chamaemorus, Ledum groenlandicum, Salix myrtillifolia* and *Salix pedicellaris.* Herbs and low shrubs commonly include *Caltha palustris, Galium trifidium, Menyanthes trifoliata, Potentilla palustris, Smilicina trifolia, Calamagrostis canadensis, Vaccinium oxycoccus,* and *V. vitis-idea.* In addition, sedges that include *Carex aquatilis, C. canescens, C. chordorrhiza, C, diandra, C. disperma, C. gynocrates, C. interior, C. lasiocarpa, C. leptalea, C. limosa, C. rostrata, C. tenuiflora,* and *C. trisperma* are common.

Brown mosses in rich fens, and *Sphagnum* in poor fens dominate the ground cover of nonpatterned, wooded fens without internal lawns. As in other peatland types, species presence is a function of the position relative to the water table as well as surface water chemistry (Gignac et al. 1991). Table 2 outlines common species found in each wooded fen type along the hummock-hollow-pool microhabitat gradient. While some species are found in more than one fen type, the common bryophytes found in each microhabitat within a fen type are unique.

TABLE 2: Common bryophyte species found in nonpatterned wooded fens along a moisture gradient (modified from Vitt 1994).

	POOR FEN	MODERATE-RICH FEN	EXTREME-RICH FEN
HUMMOCK TOP	*Dicranum undulatum* *Mylia anomala* *Pleurozium schreberi* *Pohlia nutans* *Polytrichum strictum* *Sphagnum fuscum*	*Dicranum undulatum* *Pleurozium schreberi* *Pohlia nutans* *Polytrichum strictum* *Sphagnum fuscum* *Tomenthypnum nitens*	*Dicranum undulatum* *Hylocomium splendens* *Pleurozium schreberi* *Tomenthypnum nitens*

	POOR FEN	MODERATE-RICH FEN	EXTREME-RICH FEN
HUMMOCK SIDE	*Aulacomnium palustre* *Sphagnum magellanicum*	*Aulacomnium palustre* *Drepanocladus uncinatus* *Sphagnum warnstorfii* *Tomenthypnum nitens*	*Drepanocladus vernicosus* *Hypnum pratense*
WET HOLLOWS TO POOLS	*Sphagnum angustifolium* *Drepanocladus exannulatus*	*Drepanocladus aduncus* *Bryum pseudotriquetrum* *Sphagnum teres*	*Bryum pseudotriquetrum* *Campylium stellatum* *Drepanocladus revolvens* *Meesia triquetra* *Scorpidium scorpioides*

Nonpatterned, wooded fens with islands of forested peat plateau and internal lawns (**Ftnr**)

Aerial photo interpretation

In some wooded fens, small islands of permafrost can be found that are forested exclusively with *Picea mariana* (frost mounds). These forested islands are surrounded and associated with wetter and lower areas than the surrounding wooded fen representing internal lawns. These lawns contain standing, dead trees and are dominated by graminoid species and wetter species of *Sphagnum* or brown moss than the surrounding wooded fen. A woody debris layer is present stratigraphically within internal lawns at a depth of 20-40 cm. Plants, usually growing under drier conditions, such as *Pleurozium schreberi* or *Tomenthypnum nitens*, have been found in this woody debris layer. Remnants of these forested "islands" are still present around the lawns and are recognized by a narrow zone of denser tree cover dominated by *Picea mariana*. This results in a "ghost" image of the former extent of the peat plateau that has degraded (Vitt et al. 1994).

A heterogeneous tone characterizes aerial photos of this wetland form; with a medium toned matrix interspersed with distinct, darker toned peat plateaus and "fuzzy", lighter toned internal lawns (Figure 19). Internal lawns can be ringed with a slightly darker toned border (Figures 19 and 20). Islands of peat plateaus and associated internal lawns in wooded fen are generally located along the margins of mineral uplands or large bogs.

Vegetation

Nonpatterned, wooded fens with islands of forested peat plateau and internal lawns represent a wetland type with a complex architecture of microhabitats (Figure 21). The nonpatterned wooded fen component

is identical in its microhabitat architecture to nonpatterned wooded fens without internal lawns, while the forested permafrost bog component has similar microhabitat architecture to wooded permafrost bogs. In addition, the presence of internal lawns is reflected in the occurrence of typically small lawn and carpet microhabitats that are typically restricted in area (small) in wooded nonpermafrost fens without internal lawns. As a result of this complex microhabitat architecture, canonical correspondence analyses of nonpatterned, wooded fens with islands of forested peat plateau and internal lawns sites fall between wooded bogs and nonpatterned, wooded fens without internal lawn sites (Figure 2).

As with layers and microhabitat covers, vegetation present within nonpatterned wooded fens with forested permafrost bog and internal lawns is complex. Vegetation of the nonpatterned wooded fen component is identical to that present in nonpatterned wooded fens. Tree cover is composed of varying combinations of *Larix larcinia* and *Picea mariana*, with differences in dominance a function of fen type. In addition, local areas of permafrost bog typified by tall, dense trees and a high percentage of bare peat/lichen and feathermoss communities are present as are local areas of internal lawn with carpets and lawns of *Carex* spp. with brown moss dominant in rich fens and *Sphagnum* species dominate in poor fens. As with their bog counter-parts internal lawns in fens typically contain abundant snags from the former permafrost bog (Figure 21). Forested permafrost bog and internal lawn areas are typically found adjacent to each other within the larger matrix of nonpatterned wooded fen, with pool microhabitat areas present at the interface, representing wet areas where permafrost is actively melting. Canonical correspondence analyses of vegetation from stands within nonpatterned, wooded fens with islands of forested peat plateau and internal lawns fall between wooded bogs and nonpatterned, wooded fens without internal lawns as would be expected (Figure 3). A typical nonpatterned wooded fen with forested permafrost bog and internal lawns is shown in Figure 21.

Nonpatterned, wooded fens with islands of internal lawns (**Ftni**)

Aerial photo interpretation

As with the previous wetland form, islands of internal lawns occur as wetter depressions in the surrounding wooded fen; however, unlike the previous wetland form, no small islands forested exclusively

with *Picea mariana* are present. Aerial over flights reveal the presence of dead trees tilted in random directions on the fen lawns, indicating the former existence of densely wooded, small permafrost bodies. Internal lawns are ringed by a narrow zone of denser tree cover dominated by *Picea mariana* marking the former extent of peat plateau. Internal lawns have a ground cover containing wetter species of *Sphagnum* or brown moss than the surrounding wooded fen that may be poor, moderate-rich, or extreme-rich.

As with the previous wetland form a heterogeneous tone characterizes aerial photos of wooded fens with islands of internal lawns. A medium toned matrix is interspersed with "fuzzy"; lighter toned internal lawns that can be ringed with a slightly darker toned border (Figure 22). Islands of internal lawns in wooded fen are generally located along the margins of mineral uplands or large bogs.

Vegetation

Microhabitats and vegetation within this wetland type represents a transition between nonpatterned, wooded fen with forested permafrost bog and internal lawns and nonpatterned, wooded fen without internal lawns. Species presence is largely determined by fen type, however unlike the Ftnr wetland class there are no areas of permafrost bog, hence the taller trees and associated areas of bare peat and high lichen/feather moss cover are absent. Internal lawns with carpets and lawns are present with vegetation typical of other internal lawns with vegetation dominated by *Carex* spp. and *Sphagnum* in poor fens, while brown mosses dominate in rich fens. In contrast to the Ftnr wetland class, large pools are generally absent as an actively melting permafrost component is not present (Figure 23). As a result of this complex vegetation architecture nonpatterned, wooded fens with internal lawns are not distinguishable on the layer (Figure 2) or microhabitat (Figure 3) ordination. However, the spatial partitioning of these layers and microhabitats into separate components of the wetland type reflects its distinctness (Figures 2 and 3).

Marshes (Mong)

Aerial photo interpretation

Marshes are distinguished from other wetland forms by lack of tree or shrub cover resulting in a light tone on aerial photographs. Unlike open, graminoid-dominated fens, marshes require frequent flooding and are associated with fluctuating water levels. In Alberta, marshes may be saline (Na) or calcareous (Ca) and can be distinguished from open, graminoid-dominated fens by their association with the margins of streams and lakes. Marshes are also distinguished on aerial photos by their association with shallow open water (Figure 24).

Vegetation

Marshes are open systems that do not support a tree or shrub layer. The vegetation is dominated by forbs and graminoids. Common forbs include *Epilobium ciliatum, Mentha arvensis, Polygonum amphibium, Potentilla palustris, and Typha latifolia* (Figure 25). Typical graminoids include species of *Carex, Juncus, Phragmites,* and *Scirpus,* in addition to *Calamagrostis canadensis* and *Eleocharis palustris.* Bryophytes, common in open fens, are generally absent or have very low cover values of brown mosses.

Swamps

Swamps are recognized by their location in the landscape next to water bodies that flood frequently or are associated with fluctuating water levels such as is found along peatland margins. Unlike marshes, which do not support a shrub or tree cover due to seasonally wet or regional climatic conditions, swamps are wooded or shrub covered.

Coniferous swamps (**Sfnn** and **Stnn**)

Aerial photo interpretation

Coniferous swamps are forested and have a dense tree cover that is dominated by some combination of *Picea mariana* and *Larix laricina.* They occur in Alberta in association with floodplains and streams and along the margins of some peatland complexes (Figure 26). In addition, they are often located on broad plains in association with groundwater discharge either from springs or seeps. Coniferous swamps are

recognized from aerial photographs by their position in the landscape, level topography, nonuniform tree height, and dense forest cover (Figure 27). Tree height is greater in swamps than in fens as organic accumulation is < 40 cm. Correct classification of forested *Picea mariana* swamps is difficult as canopy characteristics bear strong resemblance to upland, non-wetland *P. mariana* stands. Landscape position is often key to recognition of coniferous swamps, and fieldwork is required.

Vegetation

Coniferous swamps have a diverse assemblage of species that may be present. As this wetland type often represents a forested transition between upland and aquatic or peatland communities, species occurrences are often a function of adjacency and/or the history of paludification at a site. The tree layer is generally dominated by some combination of *Picea mariana* and *Larix laricina*. Minor species may include but are not restricted to *Abies balsamea*, *Betula papyrifera*, *Picea glauca*, *Pinus banksiana*, *Pinus contorta*, *Populus balsamifera*, and *Populus tremuloides*. Shrubs are ubiquitous and are represented by *Alnus crispa*, *A. tenuifolia*, *Cornus canadensis*, *Cornus stolonifera*, *Ledum groenlandicum*, *Linnaea borealis*, *Rosa acicularis*, *Rubus idaeus*, *Viburnum edule*, and *Vaccinium myrtilloides*, as well as species of *Ribes* and *Salix* that are generally > 2m in height. The herb layer is commonly composed of species that may include *Aralia nudicaulis*, *Calamagrostis canadensis*, *Lycopodium annotinum*, *Mertensia paniculata*, *Mitella nuda*, *Petasites palmatus*, *Rubus pubescens*, and *Vicia americana*, as well as species of *Carex* and *Equisetum*. Bryophytes are dominated by *Climacium dendroides*, *Hylocomium splendens*, *Ptilium crista-castrensis*, and *Pleurozium schreberi* in drier microhabitats and species of *Brachythecium* in wetter microhabitats.

Deciduous swamps (**Sons**)

Aerial photo interpretation

Deciduous swamps lack a tree cover and have >25% shrub cover, dominated by species of *Salix* that generally grow above 2 m. Bryophytes are uncommon due to fluctuating water tables. Deciduous swamps occur along floodplains and stream terraces, and along peatland margins. On aerial photographs deciduous swamps are recognized by their position in the landscape, a medium to dark tone, and by a "blotchy" texture that reflects the variation in shrub canopy closure. On small scale aerial

photographs shrub vegetation has a crenulate pattern that is easily distinguished (Figure 28). Deciduous swamps are differentiated from open, shrub-dominated fens by shrub size and landscape position.

Vegetation

The shrub layer of deciduous swamps is commonly composed of species of *Salix* (Figure 29), as well as *Alnus tenuifolia* and *Betula glandulosa*. Herbceous vegetation is dominated by Carex spp. and can include such species as *Calamagrostis canadensis*, *Caltha palustris*, *Galium trifidium*, *Heracleum lanatum*, *Potentilla palustris* and *Typha latifolia*.

Shallow Open Waters (Wonn)

Aerial photo interpretation

This wetland class is distinguished by its association with other wetland forms, particularly marshes in the south and thermokarst basins in the north associated with peat plateaus. On aerial photographs shallow open waters are recognized as small pools of water with smooth, to irregular margins that may be distinct or gradational (Figure 26). Mottling on the water surface is not uncommon and is caused by the presence of emergent vegetation. Water bodies with scalloped margins are often found within peatlands. These water bodies are generally not considered to be shallow open waters as they are greater than 2 m in depth and function as aquatic systems.

Vegetation

Shallow open water wetlands represent a transition between terrestrial and truly aquatic ecosystems with both emergent and submergent species present. They are characterized by species common to both terrestrial and aquatic systems, with species of *Potamogeton*, *Ranunculus*, *and Scirpus* commonly found in addition to *Callitriche verna*, *Ceratophyllum demersum*, *Hippuris vulgaris*, *Lemna minor*, *Myriophyllum spicatum*, *Nuphar variegatum*, *Polygonum amphibium*, and *Typha latifolia*

FIGURE 4: Aerial photograph of veneer bogs (Boxc/n) from the Caribou Mountains, Alberta (59° 25'N and 115° 38'W). The veneer bogs are characterized by their low angle of slope and by the presence of runnels that contain denser, taller trees and mimic drainage patterns. On flat terrain these veneer bogs grade into wooded, permafrost dominated bogs (Btxc/n).

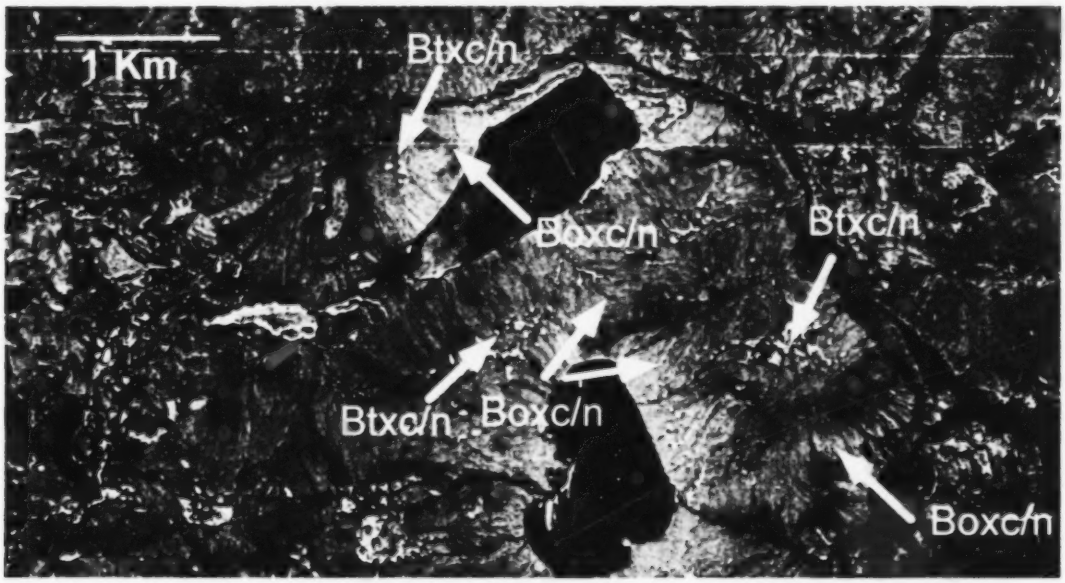


FIGURE 5: Ground view of a veneer bog. Densely treed areas represent runnels, while open shrubby areas are the inter-runnels. Permafrost is present throughout this wetland landform.

FIGURE 6: Aerial photograph of an extensive wooded permafrost bog with collapse scars from the Birch Mountains of Alberta (57° 47'N and 112° 31'W). The development of collapse scars represented by the light, bright tones on the photo have been, in some cases, linked to fire (Zoltai 1993). Burned areas (darker tone) have larger collapse scars that have integrated with drainage resulting from temporary degradation of permafrost. As vegetation is reestablished, permafrost will expand and the collapse scars will decrease in size and surface drainage will become less ordered.

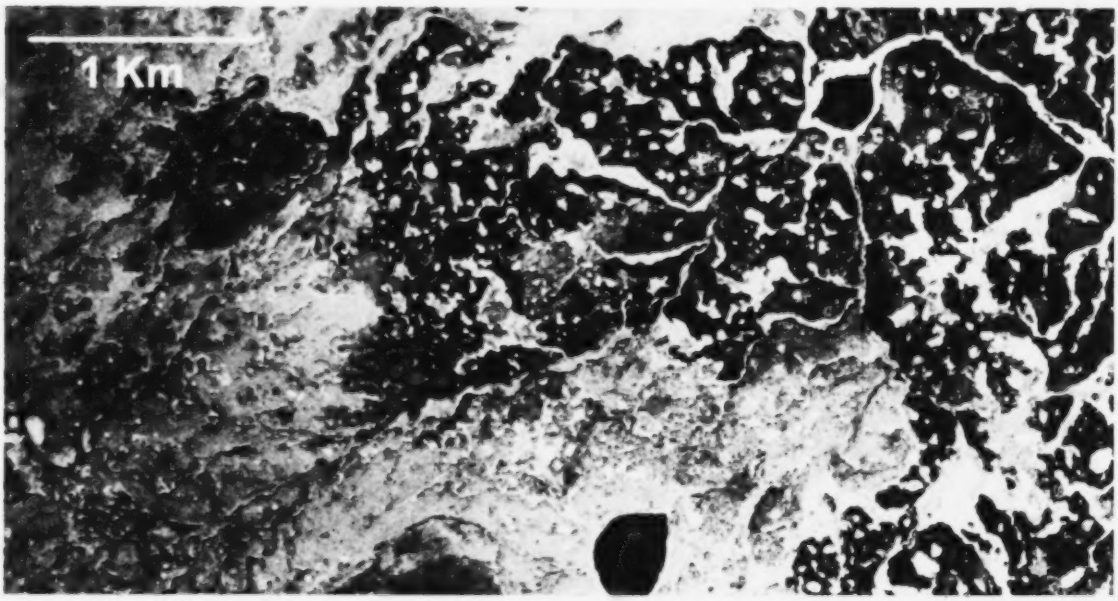


FIGURE 7: Wooded permafrost bog forested exclusively with *Picea mariana* from the Birch Mountains in northern Alberta. Collapse scars represent the light grey tone on the photo and are areas that do not contain permafrost.

FIGURE 8. Collapse scar from the Caribou Mountains, Alberta. The collapse scar is dominated by species of *Carex* and wet loving *Sphagnum*.

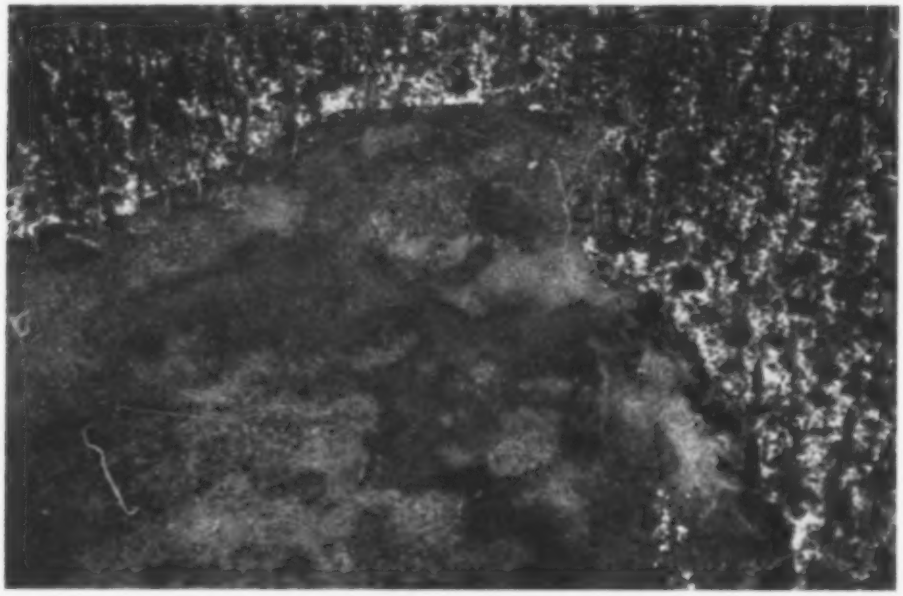


FIGURE 9. Bog islands with no internal lawns in the area of Grande Prairie, Alberta (54° 02' N and 118° 42'W). These bog islands (b) have developed as peninsulas in areas of water stagnation, within a larger fen (f). Arrows point to wetter, open areas of the fen surrounding the bog margin termed water tracks.

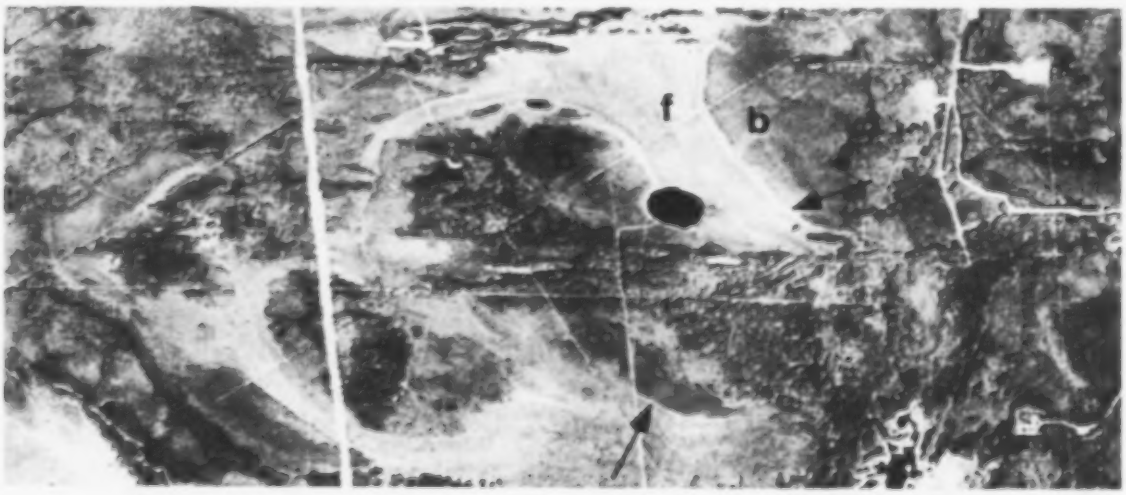


FIGURE 10. Typical ground view of a wooded bog from northern Alberta. The tree layer is exclusively forested with *Picea mariana*, with *Sphagnum* spp. dominating the ground cover.

FIGURE 11. These wooded bogs with areas of forested, permafrost bog and internal lawns (Btnr) are located near McClelland Lake, Alberta on the edge of a large, patterned fen (Fopn) (56° 25'N and 111° 15'W). The slightly elevated bogs lack surface water movement in contrast to the surrounding fen. Darker toned areas within the bog islands represent areas of forested, permafrost bog, while lighter toned areas within the bog islands represent islands of internal lawns.

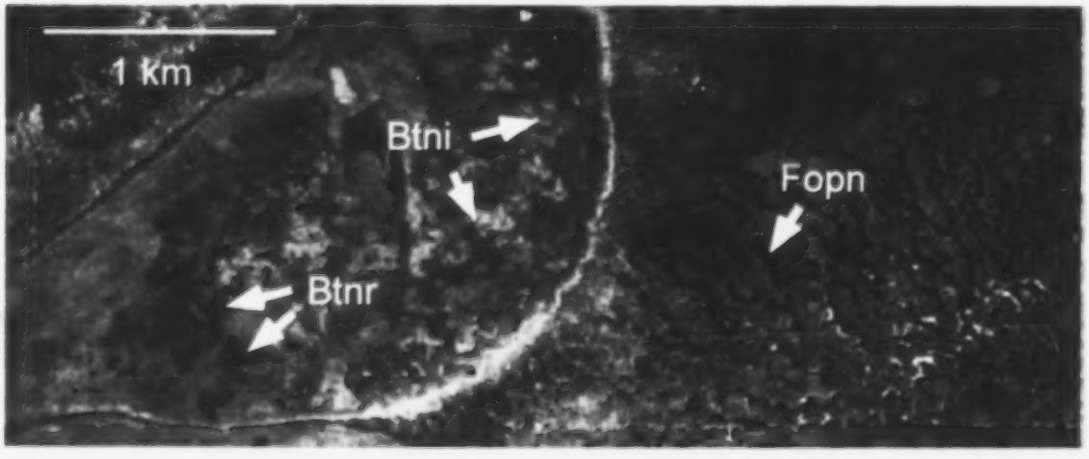


FIGURE 12. Typical view from an internal lawn looking into a relict permafrost body forested exclusively with *Picea mariana*. Unlike collapse scars, internal lawns have dead snags present.

FIGURE 13. Aerial photograph of wooded bogs with internal lawns (Btni) from eastern Alberta (55° 28' N and 111° 48' W). These bogs are occurring as islands within a larger patterned fen (Fopn/Ftpn). Arrows pointing to the irregularly shaped lighter toned areas are the internal lawns within the bog islands. The most westerly bog island (Btxc/n) still contains a substantial amount of permafrost even at this southerly latitude.

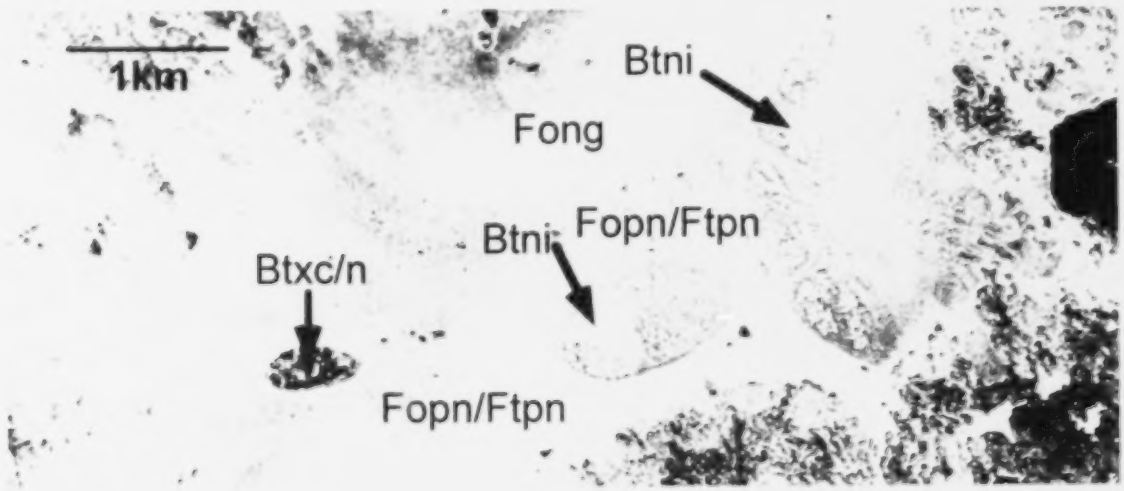


FIGURE 12: Typical view from an internal lawn looking into a relict permafrost body forested exclusively with *Picea mariana*. Unlike collapse scars, internal lawns have dead snags present.

FIGURE 13: Aerial photograph of wooded bogs with internal lawns (Btni) from eastern Alberta (55° 28' N and 111° 48' W). These bogs are occurring as islands within a larger patterned fen (Fopn/Ftpn). Arrows pointing to the irregularly shaped lighter toned areas are the internal lawns within the bog islands. The most westerly bog island (Btxc/n) still contains a substantial amount of permafrost even at this southerly latitude.

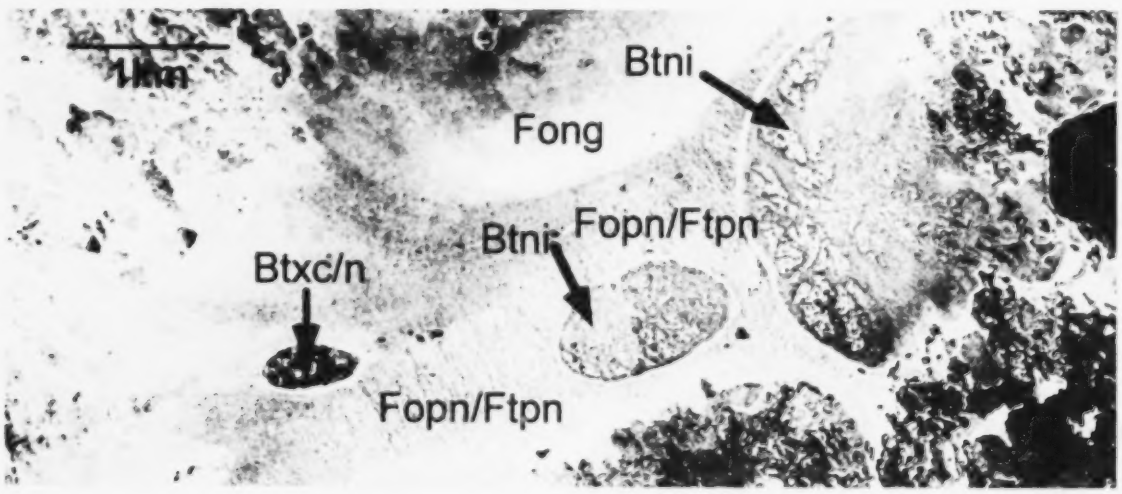


FIGURE 14: Patterned fen from northwestern Alberta (59° 01' N and 118° 23' W). The patterned fen has a reticulate pattern of dry strings (s) and wet flarks (f). In some cases permafrost has developed in the strings resulting in the formation of small, linear wooded permafrost bogs.

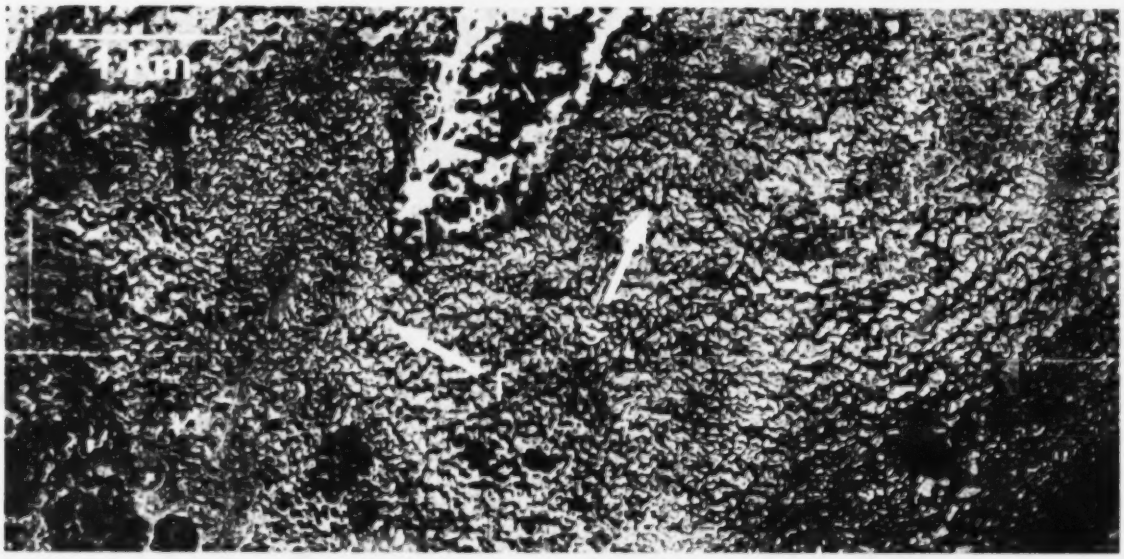


FIGURE 15: Helicopter view of a patterned fen near Audet Lake, Alberta (57° 36'N and 110° 51'W).

FIGURE 16: Open, shrub-dominated (Fons) and graminoid-dominated (Fong) fens, and a tree-dominated (Ftnn) fen from central Alberta (54° 37' N and 113° 48' W).

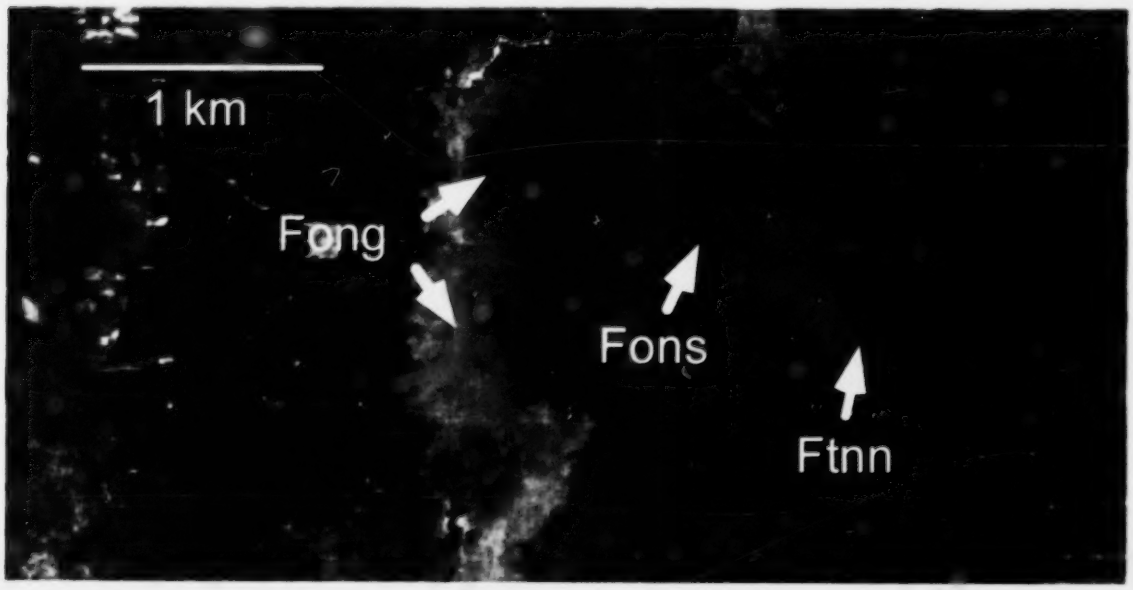


FIGURE 17: Fens within a dune complex located along the Athabasca River (54° 23' N and 115° 27' W). Light toned peatland areas consist of open, graminoid-dominated fens (o), while darker peatland areas are wooded fens with no internal lawns (t).

FIGURE 18: Nonpatterned, open graminoid-dominated fen from east central Alberta dominated by *Carex*, *Equisetum*, *Eriophorum*, and *Triglochin*.

FIGURE 19: Aerial photograph of a peatland complex from central Alberta 56° 33' N and 112° 32' W. This peatland is composed of a wooded fen with areas of internal lawns (Ftnr), and areas of wooded fen with internal lawns (Ftni). Wooded bogs with forested peat plateau and internal lawns (Btnr) are also present throughout.

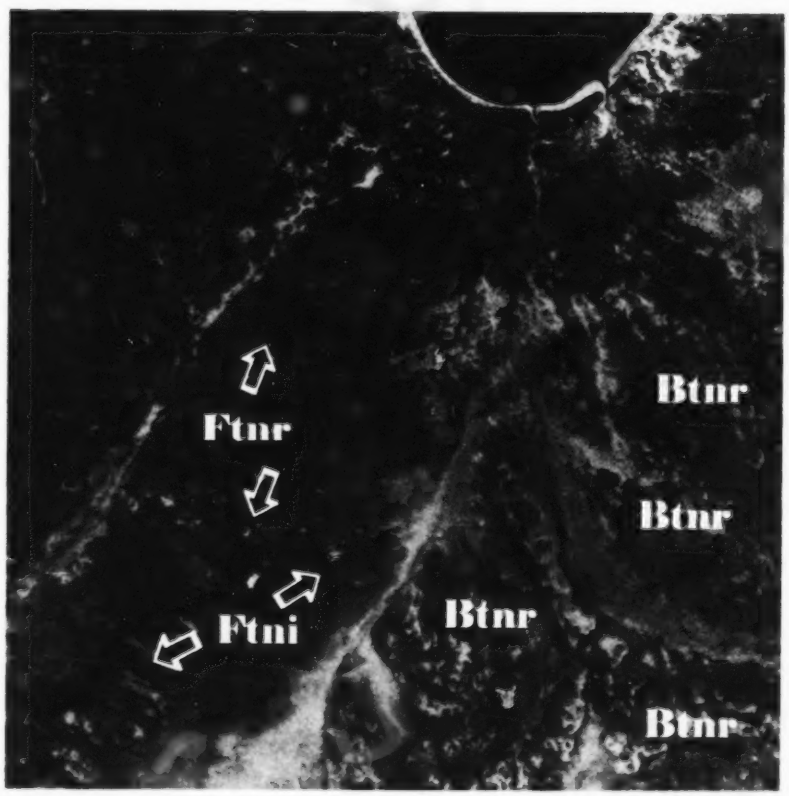


FIGURE 20. Aerial photograph of a nonpatterned wooded fen with forested permafrost bog and internal lawns.

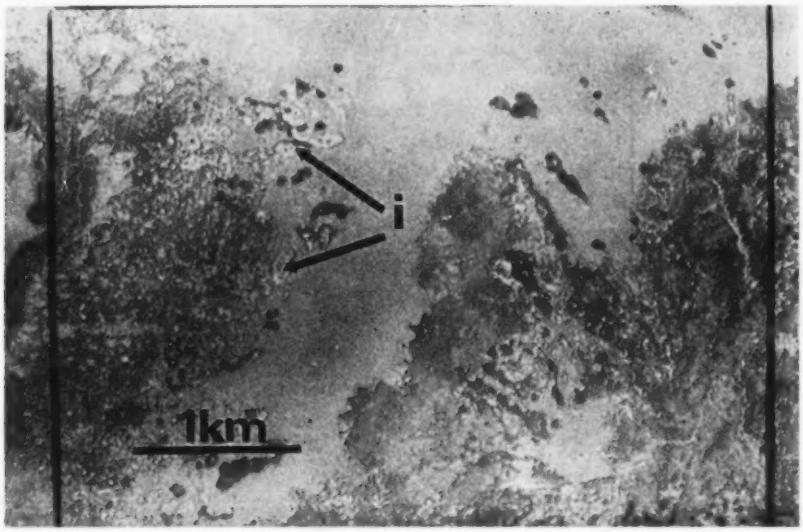


FIGURE 21. Nonpatterned wooded fen in foreground with internal lawn and wooded permafrost bog in background. Site is from northeastern Alberta near 56° 30' N and 112° 30' W.

FIGURE 22: Nonpatterned wooded fen with internal lawns from air. Arrows point to internal lawns.

FIGURE 23: Helicopter view of nonpatterned wooded fen with internal lawns. Taller rings of trees represent the margin of internal lawns.

FIGURE 24: Aerial photo of marsh surrounding pond of shallow open water south of Red Earth Creek, Alberta 56° 13'N and 115° 45'W.

FIGURE 25: Marsh/shallow open water transition from north of Devon, Alberta.

FIGURE 26: Aerial photo of a wooded swamp located along the northwest shore of Otasan Lake, Alberta.

FIGURE 27: Wooded swamp in central background of photo with wooded nonpatterned fens flanking either side.

FIGURE 28. Aerial photo of a shrubby *Salix* spp. swamp from central Alberta. Shrubby swamp runs from south to north through center of photo.

FIGURE 29. *Salix* swamp along stream channel from Elk Island National Park, Alberta.

6.0 ALLIGNMENT OF ALBERTA WETLAND INVENTORY WITH ECOSITE PHASE CLASSIFICATION

The ecosite classification system developed by Beckingham and Archibald (1996) is often used in conjunction with the Alberta Wetland Inventory Standards. Use of similar terminology for some ecosites and ecosite phases as Wetland Inventory Standards, and lack of some terminology in the ecosite and ecosite phase classification system has lead to some confusion among users. Here we present a concordance table that is focused on addressing the similarities and dissimilarities between the two classification systems.

The Alberta Wetland Inventory Standards recognizes the presence of permafrost in Alberta. Permafrost is generally found in bogs as larger peat plateaus (BTXN and BTXC) as well as veneer bogs (BOXN and BOXC), or as small frost mounds (*sensu stricto* Beilman et al. 2001) present in both bogs (BTNR) and fens (FTNR). The ecosite and ecosite phase classification of Beckingham and Archibald (1996) does not recognize permafrost in Alberta, and the Cryosolic Soil Order is not included in the field guide, though some plots particularly in the Subarctic Subregion may have contained permafrost (ecosite phases e1 and f1).

Bogs are recognized as a separate ecosite for all four subregions in Beckingham and Archibald (1996) and are represented by treed and shrubby ecosite phases: Boreal Mixedwood (BM): i1 and i2; Boreal Highlands (BH): h1 and h2; Subarctic (SB): f1 and f2; Canadian Shield (CS): f1 and f2. With the exception of the Shrubby Bog ecosite phase of the Canadian Shield Subregion (f2), all the bog ecosite phases appear to have concordance with the Alberta Wetland Inventory concept of bogs. The shrubby bog ecosite phase of the Canadian Shield did not have concordance with AWI defined bogs as organic thickness of all plots (n = 2) was less than 40 cm. In addition to the bog ecosites, additional ecosite phases in both the BM (g1 and h1), BH (i1), and SB (e1) subregions are dominated by black spruce and have $\geq$40 cm of organics. The organic thickness suggests that these ecosite phases are peatlands, with the lack of *Larix laricina* suggestive of bog vegetation, though some plots could also be representative of poor fens.

Wooded fens, both poor and rich, are recognized by Beckingham and Archibald (1996). In general ecosite phases identified as wooded poor and rich fens are in concordance with the Alberta Wetland Inventory Standards. The exceptions are the treed poor fen ecosite phase (i1) in the Boreal Highlands and Subarctic Subregions. Treed poor fens in the Boreal Highlands appear more similar to bogs as they do not support *Larix laricina* as a typical species in the tree layer (n = 1). Treed poor fens identified by Beckingham and Archibald (1996) in the Subarctic subregion are not in concordance with the Alberta Wetland Inventory Standards as over half of the plots have an organic thickness of <40 cm. These plots are more characteristic of coniferous swamps.

Shrubby fens are also recognized by Beckingham and Archibald (1996), though concordance with AWI is poor. Lack of concordance is generally a function of plots that have <40 cm of organics, and for this reason are more typical of deciduous swamps. In addition, the presence of *Picea glauca* in the shrubby rich fen community of the Boreal Highlands, and lack of bryophytes in the shrubby rich fen community of the Canadian Shield are also more typical of swamps than fens.

Graminoid-dominated open fens are found in all subregions and can be both poor and rich. While graminoid poor fens are not recognized in Beckingham and Archibald (1996) they are present within Alberta and commonly occur as lags associated with bog islands or in association with collapse scars in the Subarctic subregion. In addition they are often found in associated with acidic bedrock and in topographic highs in the landscape (Vitt et al. 1975, Halsey et al. 1997). Graminoid rich fens are present as ecosite phases, and are recognized within all subregions. While 60% of the plots that were utilized to define this ecosite phase appear to be in concordance with AWI, 40% are not. Of the plots that do not appear to be in concordance, difference is a function of organic thickness. Graminoid-dominated plots with <40 cm organics appear more typical of marshes in AWI.

While wooded swamps are not implicitly recognized within the ecosite phase classification, several ecosite phases are dominated by some combination of *Picea mariana* and *Larix larcinia* but have an organic thickness of <40 cm. These ecosite phases include BM: g1 and h1; BH: g1; SB: e1; and CS: d1. Though there is not perfect concordance as some plots have >40 cm of organics, these ecosite phases

can be typically viewed as wooded swamps. In addition, ecosite phases with communities containing species such as *Abies balsamea*, *Picea glauca*, and *Populus balsamifera* (BM: f1; BH: f1; SB: d1, d2, an d3; and CS: e1 and e2) are typically not considered swamps. However, when these species are found in association with a tree layer dominated by some combination of *Picea mariana* and *Larix larcinia* these ecosite phases can be recognized as swamps.

Shrubby swamps and marshes are typically not recognized by the ecosite phase classification with the exception of marshes in the Boreal Mixedwood Subregion. However, organic depths of <40 cm for shrubby rich fens within the Boreal Mixedwood (k2 ecosite phase) and Subarctic (h2 ecosite phase) would likely represent shrubby swamps. Organic depths of <40 cm for graminoid fens within all subregions (BM: k2; BH: h2; SB: h2, and CS: h2) likely represent marshes.

TABLE 3: Concordance of Alberta Wetland Standards with Ecosite Phase Classification of Beckingham and Archibald (1996).

Peatlands

AWI	Boreal Mixedwood	Boreal Highlands	Subarctic	Canadian Shield
Bogs **(B _ _)** -permafrost or internal lawns may or may not be present -≥ 40 cm organics -forested exclusively with *Picea mariana*	**Ecosite phase g1** **(Labrador tea-subhygric Sb-Pj)** -10% of plots have ≥80 cm organics -stands support an average of ≥10% *Pinus banksiana*	**Ecosite phase h1 and h2** **(Treed and shrubby bogs)** -Concordance	**Ecosite phase e1** **(Labrador tea-hygric Sb-Pl)** -50% of plots have ≥80 cm organics -stands support an average of ≥5% *Pinus contorta*	**Ecosite phase f1** **(Treed bog)** -Concordance
	Ecosite phase h1 **(Labrador tea/horsetail Sw-Sb)** -20% of plots have ≥40 cm organics -Lack of *Larix laricina* within the recognized plant community is more suggestive of bog vegetation			
	Ecosite phase i1 and i2 **(Treed and shrubby bogs)** -Concordance	**Ecosite phase i1** **(Treed poor fen)** -Lack of *Larix laricina* within the recognized plant community is more suggestive of bog vegetation	**Ecosite phase f1 and f2** **(Treed and shrubby bog)** -Concordance	**Ecosite phase f2** **(Shrubby bog)** -100% of plots have < 40cm of organics
Wooded fens **(FT_ _)** -≥ 40 cm organics -forested with some combination of *Picea mariana* and *Larix laricina*	**Ecosite phase j1** **(Treed poor fen)** -Concordance	**Ecosite phase i1** **(Treed poor fen)** -Lack of *Larix laricina* within the recognized plant community is more suggestive of bog vegetation	**Ecosite phase i1** **(Treed poor fen)** -60% of plots have < 40 cm organics	**Ecosite phase j1** **(Treed poor fen)** -Concordance
	Ecosite phase k1 **(Treed rich fen)** -Concordance	**Ecosite phase j1** **(Treed rich fen)** -Concordance	**Ecosite phase h1** **(Treed rich fen)** -Concordance	**Ecosite phase k1** **(Treed rich fen)** -Concordance
Shrubby fens **(FONS)** -≥ 40 cm organics -shrub layer generally ≤ 2m -bryophytes common in ground layer	**Ecosite phase j2** **(Shrubby poor fen)** -30% of plots have < 40 cm organics	**Ecosite phase i2** **(Shrubby poor fen)** -Concordance	**Ecosite phase g2** **(Shrubby poor fen)** -Concordance	**Ecosite phase g2** **(Shrubby poor fen)** -100% of plots have < 40 cm organics
	Ecosite phase k2 **(Shrubby rich fen)** -50% of plots have < 40 cm organics	**Ecosite phase j2** **(Shrubby rich fen)** -Presence of *Picea glauca* tree layer not typical	**Ecosite phase h2** **(Shrubby rich fen)** -100% of plots have < 40 cm organics	**Ecosite phase h2** **(Shrubby rich fen)** -bryophytes not identified as part of plant community
Graminoid fens **(FONG and FOPN)** -≥ 40 cm organics -bryophytes common in ground layer	-Open poor fens are not recognized	-Open poor fens are not recognized	-Open poor fens are not recognized	-Open poor fens are not recognized
	Ecosite phase k3 **(Graminoid rich fen)** -40% of plots have < 40 cm organics	**Ecosite phase h3** **(Graminoid rich fen)** -40% of plots have < 40 cm organics	**Ecosite phase h3** **(Graminoid rich fen)** -40% of plots have < 40 cm organics	**Ecosite phase h3** **(Graminoid rich fen)** -40% of plots have < 40 cm organics

TABLE 3: continued.

Nonpeat-accumulating wetlands

AWI	Boreal Mixedwood	Boreal Highlands	Subarctic	Canadian Shield
Wooded swamps (STNN) -<40 cm of organics -dominated by some combination of *Picea mariana* and *Larix laricina*	**Ecosite phase f1 (Horsetail Pb-Aw)** -Defined vegetation community not in concordance, however dominance of some combination of *Picea mariana* and *Larix laricina* with *Picea glauca* and *Populus balsamifera* and other species is suggestive of this ecosite phase.	**Ecosite phase f1 (Horsetail Sw)** -Defined vegetation community not in concordance, however dominance of some combination of *Picea mariana* and *Larix laricina* with *Picea glauca* and *Abies balsamea* and other species is suggestive of this ecosite phase.	**Ecosite phase d1, d2, and d3 (Horsetail Pb-Bw, Aw-Sw, and Sw)** -Defined vegetation community not in concordance, however dominance of some combination of *Picea mariana* and *Larix laricina* with *Picea glauca* and *Populus balsamifera* and other species is suggestive of this ecosite phase.	**Ecosite phase d1** -Concordance
	Ecosite phase g1 (Labrador tea-subhygric Sb-Pj) -10% of plots have ≥80 cm organics	**Ecosite phase g1 (Labrador tea-hygric Sb-Pj)** -Concordance	**Ecosite phase e1 (Labrador tea-hygric Sb-Pl)** -50% of plots have ≥80 cm organics	**Ecosite phase e1 and e2 (Willow/horsetail Aw-Bw-Pb and Aw-Sw-Sb)** -Defined vegetation community not in concordance, however dominance of some combination of *Picea mariana* and *Larix laricina* with *Picea glauca* and *Populus balsamifera* and other species is suggestive of this ecosite phase
	Ecosite phase h1 (Labrador tea/horsetail Sw-Sb) -20% of plots have ≥40 cm organics			
Shrubby swamps	**Not recognized**	**Not recognized**	**Not recognized**	**Not recognized**
Marsh -<40 cm organics -bryophytes not typically abundant	**Ecosite phase l1 (Marsh)** -Concordance	**Not recognized**	**Not recognized**	**Not recognized**
Shallow Open Water	**Not recognized**	**Not recognized**	**Not recognized**	**Not recognized**

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APPENDIX 1
PEAT MANAGEMENT TASK FORCE
PEATLAND INFORMATION

Summary of Completed Activities

1.0 PURPOSE

To provide information that will contribute to the orderly development and conservation of peatland ecosystems.

2.0 ASSUMPTIONS

The business plan assumes that:

- a partnership between industry, government and academia will exist;
- a variety of users require peatland information to assess economic and environmental costs and benefits of development and conservation;
- peatland information is an integral part of ecosystem management;
- the ecosystem framework that will be used for peatland description and sampling will be the Natural Regions, Subregions and Ecodistricts of Alberta;
- existing information will be used as much as possible to characterize peatland ecosystems at the provincial scale;
- new information collection is required to identify the location of potential development and conservation opportunities;
- data standards will be defined by the criteria for development and conservation agreed upon by the partners; and
- specified maps and reports will be published and made available to interested users.

3.0 INFORMATION OBJECTIVES

3.1 Peatland Resources of the Natural Regions and Subregions of Alberta

This objective addresses the task of describing what is currently known about peatland types and their distribution in Alberta, within an ecosystem framework. The description will include an assessment of values, opportunities and impacts, with such topics as threatened and endangered plants and animals, hydrologic functions, peat extraction, agriculture, forestry, and oil and gas. In addition, a classification, standard terminology and definitions for the peatland types in Alberta will be documented for use in subsequent inventories.

Results: A report, Peatland Resources of the Natural Regions and Subregions of Alberta.

Tasks: classify and define the peatland types of Alberta peatlands

- interpret air photos and compile peatland data for the project area - forty-two 1:250 000 map sheets
- digitize/scan peatland maps and generate summary statistics
- compile existing information on distribution of peatland values, development opportunities and impacts on the peat resource.
- publish and distribute report

Schedule:
- Completed in Year 1 (1996)

Uses:
- an information source for policy development and implementation
- a provincial overview of the distribution of peatland types and values that provides the context for regional decisions
- a planning tool for Special Places 2000, protected areas management, endangered species management
- shows development opportunities on a regional basis
- supports planning on an ecosystem basis
- an educational tool

3.2 Peatland Inventory

Provides maps and data that classify peatlands and evaluates them for their conservation value and for their potential for horticultural peat extraction. A five year commitment was established to evaluate the 50 000 km^2 that comprise all the potentially economically important areas of horticultural peatlands in the province. The commitment will allow the inventory program to proceed efficiently by allowing the expertise required to carry out the work to be built and retained.

For the purposes of this inventory, the natural regions, subregions and ecodistricts have been further subdivided to identify areas of more homogeneous peatland types and distribution patterns. These areas are called Peatland Management Areas (PMAs).

Results: For priority Ecodistricts/Peatland Management Areas:

- 1:50 000 black and white maps of peatland types
- 1:50 000 black and white maps of peatlands rated for conservation values and horticultural development potential
- supporting digital files and databases
- report of methods and results

Tasks:
- tabulate existing information
- interpret air photos
- identify sites and conduct field sampling
- assess development potential
- assess conservation value
- produce maps, databases and reports
- publish and distribute results

Schedule:
- Year 2: – Wabasca East (Completed in 2000 with assessment of conservation values developed in Forest 2000).
- Year 3: – Athabasca and Wabasca West (Completed in 2002).
- Year 4: – Utikima (Completion Pending)

(Update 2003 - Currently, all of the five years has been essentially completed as shown in Figure A1-1).

Uses: a balanced view of peatland distributions and values

- allows government to make detailed planning and allocation decisions, and to identify land bases for development and conservation
- areas of high potential for extraction of horticultural grade peat are identified so that site-specific deposits can be investigated in more detail by the user community
- areas with high conservation value are identified and, subsequently, further investigation can determine how they can best be managed to preserve their value
- provides caribou habitat information
- provides a baseline assessment of the peatland land base prior to development
- supports ecosystem management
- provides an opportunity for scientific investigation and the resulting increased understanding of peatlands

3.3 Peatland Information Centre

Provides for safe storage of the inventory results, documents and databases and provides for the generation of products, on a user pay basis.

Results: A Peatland Information Centre

Tasks:

- design operating strategy for centre
- organize materials and equipment and load data
- store and manage the data
- produce standard and custom products on a user pay basis

Schedule:

- operation initiated at the conclusion of Year 1 at the Devonian Botanic Garden, University of Alberta: (http://www.devonian.ualberta.ca/peatland)

Uses:

- access to the interpreted air photos for subsequent investigation
- additional copies of maps and reports for new users
- access to digital site and map data for user specific modelling
- production of custom products to identify areas of interest

Figure A1-1: Location of Completed areas for Peatland Inventory.

Figure A1-1: Location of Completed areas for Peatland Inventory.

APPENDIX 2
PEAT MANAGEMENT TASK FORCE
PEATLAND SITE INFORMATION

Site layer data collected in Year 3 (1999) by Sonja Mehelcic and David Beilman

SITE	CODE	Latitude	Longitude	pH	Conductivity (μS/cm)
01A	ftnn	54.38	111.68	6.51	76.0
02A	btnn	54.65	111.96	3.85	36.5
03A	ftnn	54.70	111.96	6.81	112.0
04A	fons	54.68	112.17	6.43	73.0
04B	ftnn	54.68	112.08	7.23	74.5
05A	btnn	54.85	111.20	4.14	23.3
06A	fons	54.85	111.25	7.13	107.5
06B	fong	54.85	111.25	7.24	104.0
07A	fons	54.88	111.29	8.35	39.3
07B	ftnn	54.88	111.79	7.13	94.5
07C	btnn	54.55	111.79	3.88	35.0
08A	stnn	54.50	111.63	7.15	62.0
09A	ftnn	54.50	111.42	7.55	273.5
10A	ftnn	54.81	112.29	6.52	40.6
10B	btnn	54.81	112.29	6.11	36.0
11A	fons	54.85	112.40	8.09	300.0
11B	stnn	54.85	112.40	8.26	372.0
12A	btnn	54.85	112.40	4.06	81.5
13A	ftnn	54.96	112.13	6.60	84.5
14A	fons	55.17	112.00	6.45	22.8
14B	btnn	55.23	112.60	3.99	23.0
14C	ftnn	55.23	112.58	5.60	49.3
15A	btnn	55.17	112.01	4.13	33.4
15B	fons	55.22	112.52	5.55	21.8
16A	fopn	54.92	112.70	7.93	80.5
17A	ftnn	54.95	112.58	6.55	20.1
18A	fong	54.86	112.99	6.86	34.1
19A	ftnn	n/a	n/a	7.98	67.9
20A	btnn	55.07	112.17	4.49	27.7
21A	btnn	55.23	112.43	4.19	20.8
21B	fons	55.23	112.43	5.82	20.1
22A	btnn	55.10	112.52	3.87	71.5
23A	ftnn	55.13	112.45	7.19	56.4
24A	stnn	55.15	112.44	8.22	170.0
25A	ftnn	55.22	112.38	8.05	88.0
26A	ftnn	55.06	112.48	9.34	92.0
27A	fons	55.27	112.45	6.94	37.2
28A	ftnn	55.20	112.52	5.60	n/a
28B	ftnn	55.18	112.53	6.68	116.0
28C	btnn	55.18	112.54	3.75	123.0
29A	ftnn	54.86	112.55	6.96	36.6
30A	fons	55.17	112.77	6.99	117.0
31A	btnn	54.86	113.00	3.80	41.6
32A	ftnn	54.78	112.98	7.22	65.0
33A	btnn	54.62	112.10	3.80	41.5
34A	btnn	54.80	112.68	4.48	181.0
35A	btnn	54.78	112.63	5.10	46.5
36A	ftnn	54.92	112.65	6.39	43.3
36B	ftnn	54.60	112.63	7.00	54.0
37A	fons	54.95	112.79	7.28	46.9

SITE	CODE	Latitude	Longitude	pH	Conductivity (µS/cm)
38A	ftnn	54.70	112.55	6.99	233.0
39A	ftnn	54.72	112.77	6.69	40.9
40A	ftni	55.92	113.69	5.89	25.1
41A	btnn	55.98	113.53	3.89	34.8
42A	fons	56.18	114.53	6.46	100.0
43A	ftnn	56.17	114.50	6.26	41.0
44A	btnn	56.15	114.57	4.02	26.4
45A	fons	56.50	115.02	7.05	63.0
46A	btnn	n/a	n/a	3.79	44.4
47A	ftnn	56.25	114.82	6.77	57.0
48A	fong	56.22	115.02	5.21	8.0
49A	ftnn	56.50	115.03	6.89	190.0
50A	stnn	56.50	114.72	7.18	146.0
51A	btxn	56.13	114.54	5.34	21.1
52A	btnn	56.05	114.32	3.99	23.6
53A	fons	55.95	114.43	6.75	73.0
54A	ftnn	55.88	114.37	9.55	59.0
55A	btnn	56.32	114.65	3.84	36.5
56A	fopn	56.25	114.48	6.91	90.0
57A	ftnn	56.20	114.33	6.76	60.0
58A	ftnn	56.23	114.12	6.41	40.0
59A	ftnn	56.32	114.07	6.34	32.8
60A	btnn	56.40	113.98	3.76	43.0
61A	fong	56.38	113.93	8.50	19.0
62A	ftnn	54.97	113.02	7.13	55.0
63A	stnn	54.98	112.97	6.20	n/a
64A	ftnn	54.90	113.28	8.58	102.0
65A	btnn	54.73	113.12	3.85	47.1
65B	fons	54.74	113.12	6.09	72.0
66A	ftnn	54.72	113.15	6.61	112.0
67A	ftnn	56.15	114.23	7.79	110.0
68A	btnn	56.12	114.08	4.63	31.8
69A	ftnn	56.38	113.57	6.88	120.0
70A	ftnr	56.32	113.68	4.04	30.4
71A	ftni	56.25	113.58	5.64	22.2
72A	fons	56.21	113.34	5.90	n/a
73A	btni	56.24	113.92	4.05	24.2
74A	fong	56.20	113.86	6.65	100.0
75A	btnn	56.27	113.54	4.11	29.9
76A	ftni	56.14	113.63	5.19	18.2
77A	fopn	56.08	113.63	6.66	30.2
78A	ftnn	56.02	113.80	6.36	84.0
79A	fons	56.04	114.50	7.09	147.0
80A	btnn	55.92	114.60	3.11	93.0
81A	btnn	55.66	114.22	3.95	24.6
82A	ftni	55.88	114.13	5.06	20.1
83A	ftnn	55.80	113.99	9.14	75.0
84A	fons	55.76	113.96	7.89	52.6
85A	stnn	55.70	113.87	5.60	n/a
86A	ftni	55.85	113.61	5.00	n/a
87A	ftnn	55.83	113.86	7.01	152.0
88A	ftnn	55.84	114.07	6.51	202.0

SITE	CODE	Latitude	Longitude	pH	Conductivity (μS/cm)
88B	fong	55.84	114.07	5.96	30.6
89A	btnn	56.03	113.92	3.78	56.0

Water table at each site. Negative values are values above peat surface.

SITE	Peat Depth (cm)	WT_1 (cm)	WT_2 (cm)	WT_3 (cm)	WT_4 (cm)	WT_5 (cm)	Mean WT (cm)
01A	190	12	19	6	24	25	17
02A	190	8	5	7	4	7	6
03A	200	5	6	7	2	5	5
04A	110	6	5	7	8	7	7
04B	430	7	5	7	7	6	6
05A	110	10	12	9	10	13	11
06A	110	9	7	10	6	8	8
06B	400	-22	-18	-20	-18	-11	-18
07A	95	-16	-19	-24	-15	-11	-17
07B	190	7	5	7	6	9	7
07C	240	36	53	23	28	20	32
08A	30	18	29	24	12	11	19
09A	195	17	7	15	9	11	12
10A	300	13	14	11	10	7	11
10B	120	29	23	25	35	16	26
11A	230	9	13	8	11	15	11
11B	210	35	15	14	21	30	23
12A	210	28	23	31	27	20	26
13A	390	31	66	39	43	23	40
14A	55	27	22	23	19	25	23
14B	110	40	53	46	47	26	42
14C	95	26	36	34	24	31	30
15A	340	40	36	42	46	38	40
15B	60	-16	-31	-24	-10	-29	-22
16A	390	n/a	n/a	n/a	n/a	n/a	n/a
17A	330	35	38	29	27	31	32
18A	310	-42	-12	-44	-50	-22	-34
19A	n/a	n/a	n/a	n/a	n/a	n/a	n/a
20A	270	46	26	38	27	29	33
21A	230	52	79	57	58	73	64
21B	190	37	33	26	31	42	34
22A	290	34	29	36	37	42	36
23A	205	32	24	53	18	42	34
24A	25	38	27	34	42	25	33
25A	90	47	33	48	32	27	37
26A	205	32	41	20	34	46	35
27A	230	17	10	12	41	31	22
28A	160	42	36	23	48	36	37
28B	200	23	24	31	36	44	32
28C	150	47	33	27	52	21	36
29A	100	27	49	52	26	30	37
30A	220	40	35	15	21	33	29
31A	310	27	54	40	39	64	45

SITE	Peat Depth (cm)	WT_1 (cm)	WT_2 (cm)	WT_3 (cm)	WT_4 (cm)	WT_5 (cm)	Mean WT (cm)
32A	260	37	28	19	40	40	33
33A	n/a	39	45	20	30	33	33
34A	80	55	38	31	18	25	33
35A	190	38	19	53	30	22	32
36A	205	38	41	34	23	54	38
36B	260	-13	-18	-14	-7	-9	-12
37A	360	26	32	19	13	33	25
38A	90	34	48	38	21	54	39
39A	213	47	57	16	27	38	37
40A	87	18	36	25	30	50	32
41A	160	60	32	17	28	46	37
42A	95	54	18	27	23	38	32
43A	100	25	32	16	38	43	31
44A	100	59	40	27	64	51	48
45A	205	20	40	38	22	9	26
46A	160	42	36	26	44	19	33
47A	95	51	35	54	21	33	39
48A	330	-33	-32	-31	-34	-33	-33
49A	195	57	38	20	34	46	39
50A	50	-24	-17	-35	-52	-46	-35
51A	90	45	51	64	32	94	57
52A	290	38	35	23	34	19	30
53A	160	-31	-15	-13	-19	-21	-20
54A	110	53	23	42	54	18	38
55A	150	39	20	57	35	32	37
56A	230	-33	-30	-49	-39	-32	-37
57A	95	31	40	51	54	22	40
58A	n/a	12	7	16	14	10	12
59A	300	49	32	26	17	36	32
60A	75	37	31	45	36	22	34
61A	240	-14	-11	-6	-10	-21	-12
62A	70	44	56	19	45	32	39
63A	60	34	41	23	46	27	34
64A	70	56	24	41	23	61	41
65A	340	61	45	38	59	34	47
65B	360	6	10	12	9	15	10
66A	205	-12	-37	-41	-24	-16	-26
67A	90	80	64	54	23	41	52
68A	210	48	61	34	34	23	40
69A	210	38	46	18	26	23	30
70A	n/a	29	38	21	63	46	39
71A	190	18	26	34	28	38	29
72A	310	16	20	24	19	13	18
73A	250	33	48	24	18	44	33
74A	290	14	61	52	47	38	42
75A	490	34	28	18	40	27	29
76A	250	56	42	20	48	32	40
77A	250	13	18	8	27	32	20
78A	210	16	38	51	35	34	35
79A	79	4	7	2	11	21	9
80A	100	60	32	44	51	26	43

SITE	Peat Depth (cm)	WT_1 (cm)	WT_2 (cm)	WT_3 (cm)	WT_4 (cm)	WT_5 (cm)	Mean WT (cm)
81A	520	34	31	22	46	21	31
82A	260	30	18	34	15	61	32
83A	75	34	35	49	39	20	35
84A	400	-24	-9	-14	-11	-16	-15
85A	60	41	52	49	18	32	38
86A	110	24	46	41	29	20	32
87A	80	70	58	44	52	36	52
88A	70	47	69	30	48	42	47
88B	190	-51	-18	-40	-34	-29	-34
89A	190	38	50	28	61	39	43
90A	190	28	55	21	38	44	37
91A	200	37	21	45	31	24	32

Landscape architecture percent cover of each layer. Note a + denotes present but < 1%. Layer 1 = Trees and shrubs >10 m; Layer 2 = Trees and shrubs 2-10 m; Layer 3 = Trees and shrubs 0.5-2 m; Layer 4 = Trees and shrubs <0.5 m; Layer 5 = Herbs; Layer 6 = Graminoids; Layer 7 = Bryophytes; Layer 8 = Lichens; Layer 9 = Aquatics; Layer 10 = Bare peat/soil; Layer 11 = water; Layer 12 = Rock; Layer 13 = Coarse Woody Debris; and 14 = # Snags.

SITE	Layer Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
01A	+	20	50	17	5	7	70	1	0	2	25	0	1	1
02A	+	15	10	50	+	8	80	20	0	2	+	0	+	1
03A	+	20	10	30	10	13	25	0	+	0	35	0	+	2
04A	0	+	55	10	6	30	20	1	+	0	40	0	5	21
04B	0	5	50	25	4	30	55	15	+	0	25	0	5	8
05A	0	15	20	5	2	+	70	20	0	+	15	+	+	5
06A	0	+	60	25	4	5	20	10	0	+	15	0	0	2
06B	0	0	0	0	0	0	0	0	0	0	98	0	0	0
07A	0	5	30	2	+	70	15	0	1	0	85	0	+	0
07B	+	20	20	10	5	10	40	0	+	0	30	0	+	0
07C	+	30	25	5	40	0	50	20	0	+	+	0	+	3
08A	+	25	+	+	12	15	50	+	0	+	10	0	+	3
09A	+	20	10	5	3	10	60	10	0	+	10	0	3	9
10A	+	20	5	5	10	12	45	8	0	+	10	0	5	12
10B	0	+	20	5	40	0	20	15	0	+	+	0	5	16
11A	+	+	25	5	4	35	20	0	+	0	35	0	+	1
11B	+	10	3	10	8	15	12	+	+	+	30	0	3	2
12A	0	45	10	5	20	0	30	10	0	+	+	0	+	0
13A	+	20	10	5	20	20	65	3	0	+	5	0	5	6
14A	0	5	2	1	3	40	10	0	0	0	45	0	0	0
14B	0	10	2	+	40	5	65	20	0	5	3	0	0	0
14C	0	10	30	4	17	7	60	7	0	1	10	0	+	2
15A	0	30	10	5	80	5	65	5	0	+	+	0	3	2
15B	0	+	10	5	3	10	5	0	2	0	55	0	0	0
16A	0	+	3	+	10	60	15	0	+	0	50	0	0	11
17A	0	5	20	5	30	12	70	5	0	1	7	0	3	0
18A	0	0	+	30	10	60	5	+	5	0	55	0	0	0
20A	0	10	25	10	60	+	65	20	0	2	3	0	+	0
21A	+	10	15	5	20	5	65	20	0	3	+	0	0	0
21B	0	0	35	10	20	60	15	2	5	0	40	0	0	0
22A	0	10	25	10	55	5	65	20	0	3	1	0	1	0
23A	+	25	10	5	50	3	60	10	0	3	10	0	+	1
24A	10	35	20	+	15	22	20	+	+	10	10	0	5	30
25A	0	10	35	10	40	35	60	10	+	1	5	0	2	0
26A	0	10	30	5	65	20	70	20	+	1	30	0	1	3
27A	0	+	30	10	20	45	20	+	+	+	40	0	0	3
28A	0	3	35	10	25	10	65	10	0	+	5	0	+	2
28B	3	40	20	5	25	10	40	5	0	+	10	0	+	0
28C	0	30	20	10	35	10	70	20	0	+	1	0	+	0
29A	0	10	25	10	40	10	70	25	0	+	+	0	0	0
30A	0	0	4	15	20	65	20	+	0	0	25	0	0	2

SITE	Layer Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
31A	0	35	10	2	4	2	85	15	0	3	+	0	+	10
32A	2	30	15	28	7	25	80	4	0	2	15	0	+	5
33A	0	10	10	70	2	1	70	20	0	10	+	0	0	5
34A	0	30	20	10	40	5	70	20	0	10	+	0	+	0
35A	0	30	10	20	65	5	75	25	0	5	+	0	1	0
36A	0	35	10	20	60	10	70	20	0	+	10	0	5	16
36B	0	20	10	10	25	80	20	0	1	0	90	0	0	0
37A	+	10	5	20	5	60	30	0	+	+	20	0	0	1
38A	3	40	10	10	35	20	60	10	+	+	10	0	+	0
39A	+	30	10	2	20	40	75	20	+	+	10	0	+	3
40A	0	5	2	3	20	60	70	5	+	0	30	0	0	5
41A	+	40	10	2	50	5	50	30	0	+	0	0	+	2
42A	0	+	40	10	10	60	50	5	+	+	20	0	0	0
43A	5	10	40	5	30	60	30	+	+	+	40	0	5	0
44A	0	50	10	5	60	3	70	30	0	+	+	0	0	0
45A	0	0	30	10	+	70	10	+	+	+	65	0	0	0
46A	0	30	10	5	50	5	60	40	0	5	+	0	0	0
47A	0	30	10	5	30	20	60	10	0	+	10	0	0	3
48A	0	0	0	2	60	80	5	0	+	0	85	0	0	0
49A	5	10	10	5	10	40	50	10	+	+	20	0	10	41
50A	+	40	20	10	10	60	5	+	+	+	50	0	+	16
51A	20	60	+	+	30	+	80	5	0	+	10	0	40	9
52A	0	30	10	10	60	10	80	20	0	+	2	0	+	2
53A	0	2	40	10	10	60	30	+	+	+	60	0	0	15
54A	3	50	10	5	50	10	50	10	0	+	10	0	+	6
55A	0	40	10	5	60	4	65	20	0	+	0	0	+	38
56A	0	2	20	5	10	70	5	+	+	0	85	0	0	6
57A	2	30	20	10	50	10	65	10	0	+	5	0	2	2
58A	0	5	20	10	10	60	40	+	+	+	35	0	+	0
59A	10	30	20	10	60	10	50	10	0	+	25	0	+	8
60A	+	40	10	10	60	5	70	35	0	+	0	0	+	2
61A	0	0	10	5	10	80	60	0	+	+	25	0	0	0
62A	+	40	20	5	20	5	45	5	0	+	10	0	5	9
63A	20	40	2	2	60	5	35	10	+	2	20	0	5	3
64A	2	20	10	2	60	+	65	10	0	+	+	0	1	2
65A	+	40	10	5	65	2	80	20	0	+	+	0	+	0
65B	0	0	60	10	10	40	35	+	+	+	15	0	0	0
66A	0	35	10	20	10	20	35	+	+	+	20	0	+	2
67A	0	20	10	10	75	2	80	20	0	+	8	0	5	3
68A	0	35	20	5	55	2	60	30	0	2	+	0	+	0
69A	+	10	60	20	30	40	50	5	+	+	15	0	3	24
70A	0	30	30	5	10	+	80	35	0	+	5	0	5	6
71A	+	10	20	30	40	75	80	10	0	+	25	0	+	2
72A	0	0	60	10	40	40	20	0	+	0	50	0	0	0
73A	0	40	10	5	20	55	85	10	0	+	5	0	+	0
74A	0	0	60	10	25	50	40	0	0	0	20	0	0	0
75A	0	35	15	10	65	+	80	20	0	+	5	0	2	7
76A	+	30	10	20	50	65	85	10	+	5	25	0	2	11
77A	0	5	15	10	25	75	25	+	+	0	20	0	0	0
78A	5	20	10	10	15	40	70	5	0	+	10	0	5	8
79A	0	20	10	2	10	70	20	5	0	+	5	0	5	4
80A	0	20	10	5	65	5	85	35	0	3	0	0	5	47

SITE	Layer Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
81A	0	35	10	3	70	10	80	10	0	+	8	0	2	12
82A	5	30	20	10	45	40	85	20	0	+	20	0	5	5
83A	0	40	10	5	35	30	70	15	0	+	3	0	5	14
84A	0	2	3	1	25	65	80	0	+	0	15	0	0	52
85A	0	40	10	5	65	10	50	2	0	+	10	0	4	0
86A	+	40	10	10	30	20	70	20	0	+	10	0	1	3
87A	+	45	10	5	40	5	70	10	0	+	+	0	+	4
88A	10	40	10	2	60	10	80	15	0	1	+	0	5	17
88B	0	0	2	1	30	85	60	0	3	0	35	0	0	0
89A	5	35	10	10	60	+	80	15	0	2	0	0	3	5
90A	3	40	10	5	50	50	40	10	0	10	5	0	5	2
91A	0	30	10	10	35	20	65	20	0	+	10	0	5	3

APPENDIX 3
PEAT MANAGEMENT TASK FORCE
PEATLAND INFORMATION

Site vegetation data collected in Year 3 (1999) by Sonja Mehelcic and David Beilman.

Layer 1 = Trees > 10m; Layer 2= Tree/shrubs 2 – 10m; Layer 3 = Tree/shrubs 0.5 to 2m; Layer 4 = Tree/shrubs <0.5m.; Layer 5 = Herb; Layer 6 = Graminoid; Layer 7 = Bryophytes; Layer 8 = Lichens; Layer 9 = Aquatic.

Cover values: 0.01 = rare, 1 = uncommon, 2 = common, 3 = ubiquitous

Appendix 3

Species	Code	Site Layer	01A ftnn	02A btnn	03A ftnn	04A fons	04B ftnn	05A btnn	06A fons	06B fong	07A fons	07B ftnn	07C btnn	08A stnn	09A ftnn	10A ftnn	10B btnn	11A fons	11B stnn	12A btnn	13A ftnn	14A fons	14B btnn
Larix laricina	lar_lar	1	0.01					0.01				0.01							3		0.01		
Picea mariana	pic_mar	1												0.01	1								
Alnus rugosa	aln_rug	2																					
Betula papyrifera	bet_pap	2				3			1														
Betula pumila	bet_pum	2							3														
Larix laricina	lar_lar	2	3		3		3					3	1	1	2	3		1	1		3		
Picea mariana	pic_mar	2	3	3	2			3					3	3	3	3	1			3	3		3
Pinus banksiana	pin_ban	2																					
Populus tremuloides	pop_tre	2																					
Salix bebbiana	sal_beb	2																					
Salix discolor	sal_dis	2																					
Salix exigua	sal_exi	2										1											
Salix maccalliana	sal_mac	2																					
Salix myrtillifolia	sal_myr	2																					
Salix planifolia	sal_pla	2							3														
Salix scouleriana	sal_sco	2																					
Alnus rugosa	aln_rug	3																					
Betula glandulosa	bet_gla	3																					
Betula papyrifera	bet_pap	3	0.01											0.01								1	
Betula pumila	bet_pum	3	3			3	3					3							3				
Larix laricina	lar_lar	3	3		3	1	3					3				3	0.01	0.01			2		
Picea mariana	pic_mar	3	3	3	3		2	3					3		3	2	1			3	2		3
Pinus banksiana	pin_ban	3						1															
Populus balsamifera	pop_bal	3																0.01					
Salix arbusculoides	sal_arb	3																					
Salix bebbiana	sal_beb	3										3							2				
Salix candida	sal_can	3				3	3					2											
Salix discolor	sal_dis	3																1					
Salix maccalliana	sal_mac	3							2					3									
Salix myrtillifolia	sal_myr	3								2													
Salix pedicellaris	sal_ped	3									3				0.01							3	
Salix planifolia	sal_pla	3														2							
Salix pyrifolia	sal_pyr	3																					
Salix serissima	sal_ser	3																				2	
Alnus crispa	aln_cri	4																				1	
Alnus rugosa	aln_rug	4																				3	
Andromeda polifolia	and_pol	4	3					3															
Betula glandulosa	bet_gla	4			3										2	2		2					
Betula papyrifera	bet_pap	4								1													
Betula pumila	bet_pum	4					3														3		
Chamaedaphne calyculata	cha_cal	4						3															
Empetrum nigrum	emp_nig	4															1						
Larix laricina	lar_lar	4			2																		
Ledum groenlandicum	led_gro	4	3	3	3	3	3	3				1	3	2	3	3	3			3	3		3

Species	Code	Site Layer	01A ftnn	02A btnn	03A ftnn	04A fons	04B ftnn	05A btnn	06A fons	06B fong	07A fons	07B ftnn	07C btnn	08A stnn	09A ftnn	10A ftnn	10B btnn	11A fons	11B stnn	12A btnn	13A ftnn	14A fons	14B btnn
Linnaea borealis	lin_bor	4												3									
Lonicera involucrata	lon_inv	4												3									
Lonicera vilosa	lon_vil	4							3														
Myrica gale	myr_gal	4				3																	
Picea mariana	pic_mar	4						2	2			0 01	2						0 01	1			2
Prunus virginiana	pru_vir	4																					
Ribes hudsonianum	rib_hud	4												2									
Ribes oxyacanthoides	rib_oxy	4																					
Rosa acicularis	ros_aci	4																					
Rubus chamaemorus	rub_cha	4	0 01	3				3					3	2	2	1	3			3			2
Rubus acaulis	rub_aca	4				2	1		3	2		2		2	3				1		2	2	
Rubus idaeus	rub_ida	4																					
Salix arbusculoides	sal_arb	4																					
Salix bebbiana	sal_beb	4					2																
Salix candida	sal_can	4					2																
Salix discolor	sal_dis	4																					
Salix exigua	sal_exi	4																3	2				
Salix lucida	sal_luc	4	3																				
Salix maccalliana	sal_mac	4																					
Salix myrtillifolia	sal_myr	4																			0 01		
Salix pedicellaris	sal_ped	4																1	1				
Salix petiolaris	sal_pet	4	1																				
Salix planifolia	sal_pla	4																					
Salix pyrifolia	sal_pyr	4																					
Salix scouleriana	sal_sco	4																					
Salix serissima	sal_ser	4																					
Salix sp	sal_sp	4			2																		
Vaccinium myrtilloides	vac_myr	4								1													
Vaccinium oxycoccus	vac_oxy	4	3	3	3	2	3	3	3			3	3		3	3	2			2	3		2
Vaccinium uliginosum	vac_uli	4															0 01						
Vaccinium vitis-idaea	vac_vit	4	2	3		3	2	3					3	1	3	3	3			3	3		3
Achillea millefolium	ach_mil	5																					
Aster ciliolatus	ast_cil	5																					
Aster puniceus	ast_pun	5																					
Astragalus americanus	ast_ame	5																					
Caltha palustris	cal_pal	5			2	1			2	1	1	3		3	1	2		3	2			1	
Cicuta bulbifera	cic_bul	5										1							1				
Cicuta maculata	cic_mac	5									3												
Cornus canadesis	cor_can	5																	1				
Cornus stolonifera	cor_sto	5																			0 01		
Drosera rotundifolia	dro_rot	5					2																
Epilobium angustifolium	epi_ang	5										0 01		1	1								
Epilobium ciliatum	epi_cil	5					3																
Epilobium leptophyllum	epi_lep	5																					

Species	Code	Site Layer	01A ftnn	02A btnn	03A ftnn	04A fons	04B ftnn	05A btnn	06A fons	06B fong	07A fons	07B ftnn	07C btnn	08A stnn	09A ftnn	10A ftnn	10B btnn	11A fons	11B stnn	12A btnn	13A ftnn	14A fons	14B btnn
Epilobium palustre	epi_pal	5									3	1		1	2				1		2		
Equisetum arvense	equ_arv	5																					
Equisetum fluviatile	equ_flu	5	2															2	2			1	
Equisetum pratense	equ_pra	5																				2	
Equisetum sylvaticum	equ_syl	5																					
Galium boreale	gal_bor	5																					
Galium labradoricum	gal_lab	5																					
Galium trifidum	gal_trd	5												1	1	1		1	3		0.01		
Galium triflorum	gal_trf	5								3	2	2		2					1				
Geocaulon lividum	geo_liv	5													1								
Geum macrophyllum	geu_mac	5									1			0.01									
Habenaria hyperborea	hab_hyp	5																					
Hippuris vulgaris	hip_vul	5																					
Impatiens capensis	imp_cap	5																					
Lycopodium annotinium	lyc_ann	5																					
Lysimachia thyrsiflora	lys_thy	5																				2	
Menyanthes trifoliata	men_tri	5	2		3										1	1							
Mitella nuda	mit_nud	5												3	3	2			2		1		
Moneses uniflora	mon_uni	5																					
Parnassia palustris	par_pal	5																	0.01				
Pedicularis labradorica	ped_lab	5																					
Penstemon procerus	pen_pro	5				2																	
Petasites palmatus	pet_pal	5																					
Petasites sagittatus	pet_sag	5																				2	
Petasites vitifolius	pet_vit	5																					
Potentilla palustris	pot_pal	5	3		3	3	3		2	3	3	3			1	3			2			1	
Pyrola asarifolia	pyr_asa	5																					
Pyrola minor	pyr_min	5										3		1	3			2					
Pyrola secunda	pyr_sec	5																					
Pyrola virens	pyr_vir	5																	2				
Ranunculus gmelinii	ran_gme	5									1												
Ribes lacustre	rib_lac	5																				0.01	
Ribes triste	rib_tri	5																					
Rumex crispus	rum_cri	5				2																	
Rumex occidentalis	rum_occ	5								3	2	2		1	1	2		2			0.01	2	
Salix serissima	sal_ser	5																					
Scheuchzeria palustris	sch_pal	5																					
Scutellaria galericulata	scu_gal	5									1												
Senecio pauciflorus	sen_pau	5																					
Sium suave	siu_sua	5								2													
Smilacina trifolia	smi_tri	5	3		3	3	3	3	3			3		2	2	2	3	3	3	2	1		3
Spiranthes romanzoffiana	spi_rom	5																					
Stellaria calycantha	ste_cal	5																					

Species	Code	Site Layer	01A ftnn	02A btnn	03A ftnn	04A fons	04B ftnn	05A btnn	06A fons	06B fong	07A fons	07B ftnn	07C btnn	08A stnn	09A ftnn	10A ftnn	10B btnn	11A fons	11B stnn	12A btnn	13A ftnn	14A fons	14B btnn
Stellaria longifolia	ste_lon	5																					
Trientalis borealis	tri_bor	5										0.01			2								
Triglochin maritima	tri_mar	5										0.01				3							
Triglochin palustris	tri_pal	5																					
Vicia americana	vic_ame	5																					
Viola palustris	vio_pal	5																					
Viola renifolia	vio_ren	5																					
Agrostis scabra	agr_sca	6																					
Calamagrostis canadensis	cal_can	6				3	2		2	3	3			3	3				2		2	3	
Calamagrostis inexpansa	cal_ine	6																					
Carex aquatilis	car_aqu	6	3		3	3	3		3	3	3	3		3		2		3	3			3	
Carex canescens	car_can	6																					
Carex chordorrhiza	car_cho	6																					
Carex diandra	car_dia	6																					
Carex disperma	car_dis	6																					
Carex gynocrates	car_gyn	6																					
Carex interior	car_int	6																					
Carex lasiocarpa	car_las	6																			3		
Carex leptalea	car_lep	6																					
Carex limosa	car_lim	6														3							
Carex pauciflora	car_pau	6																					
Carex prairea	car_pra	6																3	3		2		
Carex rostrata	car_ros	6																					
Carex tenera	car_ten	6																					
Carex trisperma	car_tri	6																					
Deschampsia caespitosa	des_cae	6																					
Eriogonum androsaceum	eri_and	6																					
Eriophorum polystachion	eri_pol	6																					
Eriophorum vaginatum	eri_vag	6		3		3		3					1			0.01	1						2
Glyceria grandis	gly_gra	6																					
Glyceria striata	gly_str	6																					
Phragmites australis	phr_aus	6																					
Scirpus pallidus	sci_pal	6														3							
Typha latifolia	typ_lat	6	0.01																				
Amblystegium riparium	amb_rip	7								3	2	2		1				2	2			2	
Amblystegium serpens	amb_ser	7									3							2	2		1	2	
Aulacomnium palustre	aul_pal	7			3					3	3	3	1	3	3	3	1	2	3	2	3	1	2
Blephorostroma trichophyllum	ble_tri	7														1					1		
Bracythecium sp.	bra_sp	7												2	1			3	2		1	3	
Bryum pseudotriquetrum	bry_psu	7												2	2			2			2		
Calliergidium tundrae	cal_tun	7																					
Calliergon cordifolium	cal_cor	7												2		2		1	2		2	2	
Calliergon giganteum	cal_gig	7																					
Calliergon richardsonii	cal_ric	7												1									

Species	Code	Site Layer	01A ftnn	02A btnn	03A ftnn	04A fons	04B ftnn	05A btnn	06A fons	06B fong	07A fons	07B ftnn	07C btnn	08A stnn	09A ftnn	10A ftnn	10B btnn	11A fons	11B stnn	12A btnn	13A ftnn	14A fons	14B btnn
Calliergon stramineum	cal_str	7													1	2					1		
Campylium chrysophyllum	cam_chr	7																					
Campylium polygamum	cam_pol	7									3												
Campylium radicale	cam_rad	7																					
Campylium stellatum	cam_ste	7														1							
Cephalozia connivens	cep_con	7																					
Cephalozia linulifolia	cep_lin	7											2		1							1	
Cephalozia pleniceps	cep_ple	7																			1		
Cephalozia sp.	cep_sp	7														1							
Cephaloziella hampeana	cep_ham	7																			1		
Cephaloziella spinigera	cep_spi	7																			1	1	
Ceratodon purpureus	cer_pur	7												2	2	1		1			1		
Climacium dendroides	cli_den	7							0.01		2	2		2									
Dicranum acutifolium	dic_acu	7																					
Dicranum elongatum	dic_elo	7																		2			
Dicranum fragilifolium	dic_fra	7												2					1				
Dicranum fuscescens	dic_fus	7																					
Dicranum polysetum	dic_pol	7								1											2		0.01
Dicranum undulatum	dic_und	7		2	3		2	3				1	2	1		2	2			2	2		2
Drepanocladus aduncus	dre_adu	7													1			3	2		1		
Drepanocladus exannulatus	dre_exa	7												1					1			1	
Drepanocladus fluitans	dre_flu	7																					
Drepanocladus revolvens	dre_rev	7									1			2									
Drepanocladus uncinatus	drep_unc	7								3		1		2	1				2	1	1		
Drepanocladus vernicosus	dre_ver	7																					
Eurhynchium pulchellum	eur_pul	7																					
Helodium blandowii	hel_bla	7										3		2	3			1	2		1	2	
Hylocomium splendens	hyl_spl	7											2	1	2				2		2		
Hypnum pratense	hyp_pra	7										2	1	1	2						2		
Isopterygium pulchellum	iso_pul	7																					
Jamesoniella autumnalis	jam_atu	7																					
Lepidozia reptans	lep_rep	7																		2			
Leptobryum pyriforme	lep_pyr	7																			1		
Lophocolea bidentata	lop_bid	7																		2			
Lophozia sp.	lop_sp	7																	1		1	1	
Marchantia polymorpha	mar_pol	7																			1		
Meesia triquetra	mee_tri	7																					
Mylia anomala	myl_ano	7		3				3					3			1	1			3	1		2
Myurella julacae	myr_jul	7																					
Paludella squarrosa	pal_squ	7																			0.01		
Plagiochila porelloides	pla_por	7													1	1							
Plagiomnium cuspidatum	pla_cus	7																					
Plagiomnium ellipicum	pla_ell	7								2		1		2	2			3	3		2	3	
Plagiothecium laetum	pla_den	7														1					1		

Species	Code	Site Layer	01A ftnn	02A btnn	03A ftnn	04A fons	04B ftnn	05A btnn	06A fons	06B fong	07A fons	07B ftnn	07C btnn	08A stnn	09A ftnn	10A ftnn	10B btnn	11A fons	11B stnn	12A btnn	13A ftnn	14A fons	14B btnn
Pleurozium schreberi	ple_sch	7	1	3		1		1	1				3	3	3	2	1		2	3	3	2	2
Pohlia nutans	poh_nu	7		3				3	3			3	2	1		2	1		1	2	2		2
Polytrichum commune	pol_com	7																					
Polytrichum strictum	pol_str	7	3	3	3	3	3	3	3			2	3	1	3	3	1			3	3		2
Ptilidium ciliare	pti_cil	7											2		2	1			1	2	1		
Ptilium crista-castrensis	pti_cri	7			2	1								2						2	1		
Pylaisiella polyantha	pyl_pol	7																					
Rhizomnium gracile	rhi_gra	7																					
Rhizomnium pseudopunctatum	rhi_pse	7										1		1		1		1					
Scorpidium scorpioides	sco_sco	7																					
Sphagnum angustifolium	sph_ang	7	2	2	3	3	3	2	3				2		3	3				3	3	1	2
Sphagnum centrale	sph_cen	7																					
Sphagnum fuscum	sph_fus	7		3				3					3	2	1		3			3			3
Sphagnum jensenii	sph_jen	7																					
Sphagnum magellanicum	sph_mag	7	3	2		0.01		3						1						3	3		1
Sphagnum nemoreum	sph_nem	7			2								1			1	2						
Sphagnum obtusum	sph_obt	7																					
Sphagnum riparium	sph_rip	7																					
Sphagnum russowii	sph_rus	7																					
Sphagnum squarrosum	sph_squ	7				2			3					1		2						1	
Sphagnum subsecundum	sph_sub	7																					
Sphagnum teres	sph_ter	7																					2
Sphagnum warnstorfii	sph_war	7										2			2								
Splachnum sphaericum	spl_sph	7																					
Tetraphis pellucida	tet_pel	7																					
Tetraplodon angustatus	tet_ang	7																					
Thiudium recognitum	thi_rec	7										1						1			1		
Tomenthypnum falcifolium	tom_fal	7														2							
Tomenthypnum nitens	tom_nit	7	3		3	2	3		2			3	1		3	3		2	2		3		
Cladina mitis	cla_mit	8	2	3			0.01	3					3	2	1		3			3	3		3
Cladina rangiferina	cla_ran	8		2									2								1		
Cladina sp.	cla_sp	8		3																			
Cladina stellaris	cla_ste	8											0.01										
Icmadophila ericetorum	icm_eri	8		1									1				0.01			0.01			
Peltigera aphthosa	pel_aph	8				1																	
Peltigera leucophlebia	pel_leu	8																					
Peltigera malacea	pel_mal	8																				1	
Peltigera neopolydactyla	pel_neo	8	1			2	2	1	1				1								1		
Lemna minor	lem_min	9																					
Utricularia intermedia	utr_int	9																					
Utricularia vulgaris	utr_vul	9																					

Species	14C ftnn	15A btnn	15B fons	16A fopn	17A ftnn	18A fong	19A ftnn	20A btnn	21A btnn	21B fons	22A btnn	23A ftnn	24A stnn	25A ftnn	26A ftnn	27A fons	28A ftnn	28B ftnn	28C btnn	29A ftnn	30A fons
Larix laricina	0.01						0.01					1	2	1	1						
Picea mariana																					
Alnus rugosa													2								
Betula papyrifera													0.01								
Betula pumila																					
Larix laricina	2			0.01	3		3		1				2	2	3		2			3	
Picea mariana	3	3			3		3	3	3	1	3	3	3	3	2		3		3	3	
Pinus banksiana									0.01												
Populus tremuloides			1																		
Salix bebbiana																					
Salix discolor													1								
Salix exigua																					
Salix maccalliana																					
Salix myrtillifolia																					
Salix planifolia																					
Salix scouleriana																		2			
Alnus rugosa																					
Betula glandulosa																					
Betula papyrifera																0.01					
Betula pumila			3	2			3			3											3
Larix laricina				2	3		3			1					2	1		3			
Picea mariana	3	3			3		3	3	3		3	3	1	3	2		3	2	3	3	
Pinus banksiana																					
Populus balsamifera																					
Salix arbusculoides	3													2							
Salix bebbiana																					
Salix candida																					2
Salix discolor																					
Salix maccalliana													2							3	3
Salix myrtillifolia			3					1		3											2
Salix pedicellaris										3						2	2				
Salix planifolia			2																		
Salix pyrifolia																					
Salix serissima																					
Alnus crispa																					
Alnus rugosa													1								
Andromeda polifolia				2	2		2	2							2						
Betula glandulosa																					
Betula papyrifera																					0.01
Betula pumila	2											2		1	3	3	2	1		2	
Chamaedaphne calyculata																					
Empetrum nigrum								2			1										
Larix laricina																		1			
Ledum groenlandicum	3	3		1	3		3	3	3	2	3	3	2	3	2	2	3	1	3	3	2

Species	14C ftnn	15A btnn	15B fons	16A fopn	17A ftnn	18A fong	19A ftnn	20A btnn	21A btnn	21B fons	22A btnn	23A ftnn	24A stnn	25A ftnn	26A ftnn	27A fons	28A ftnn	28B ftnn	28C btnn	29A ftnn	30A fons
Linnaea borealis													2					2			
Lonicera involucrata																					
Lonicera vilosa				1														1		2	1
Myrica gale			1																		
Picea mariana	2	2						3	3		3										
Prunus virginiana																					
Ribes hudsonianum														0.01							
Ribes oxyacanthoides																					
Rosa acicularis																					
Rubus chamaemorus		3						3	3		2	2		2	1	1	2		2	3	
Rubus acaulis	2			2						2			2	0.01		2	2	2			2
Rubus idaeus																					
Salix arbusculoides																					
Salix bebbiana												2									
Salix candida				0.01																	
Salix discolor																					
Salix exigua																					
Salix lucida																					
Salix maccalliana			1									1		2			1				
Salix myrtillifolia	2					2						2					2				
Salix pedicellaris			2	3	3	2	3								2					3	1
Salix petiolaris																					
Salix planifolia												2	1								
Salix pyrifolia																					
Salix scouleriana												2	2								
Salix serissima																					
Salix sp.																					
Vaccinium myrtilloides																					
Vaccinium oxycoccus	3	3	1	2	3		3	2	3	2	2	2		3	2	2	3			3	2
Vaccinium uliginosum											1										
Vaccinium vitis-idaea	3	3						3	3	3	3	3	2	3	3		3		3	3	
Achillea millefolium													2	1							
Aster ciliolatus																					
Aster puniceus													2								
Astragalus americanus																					
Caltha palustris							1			2					2	1					
Cicuta bulbifera																					
Cicuta maculata																					
Cornus canadesis																					
Cornus stolonifera																					
Drosera rotundifolia							2	1			2				1						
Epilobium angustifolium													2								
Epilobium ciliatum																					
Epilobium leptophyllum																					

Species	14C ftnn	15A btnn	15B fons	16A fopn	17A ftnn	18A fong	19A ftnn	20A btnn	21A btnn	21B fons	22A btnn	23A ftnn	24A stnn	25A ftnn	26A ftnn	27A fons	28A ftnn	28B ftnn	28C btnn	29A ftnn	30A fons
Epilobium palustre													1				1	1			
Equisetum arvense	2												3	3							
Equisetum fluviatile	2		2	3			2			1					1						1
Equisetum pratense																					
Equisetum sylvaticum														2							
Galium boreale																					
Galium labradoricum																					
Galium trifidum			2							1					2	2					1
Galium triflorum				2									2								
Geocaulon lividum																					
Geum macrophyllum																					
Habenaria hyperborea																					
Hippuris vulgaris																					
Impatiens capensis																					
Lycopodium annotinium																					
Lysimachia thyrsiflora																					
Menyanthes trifoliata				3			1								2						
Mitella nuda												1		1				2			
Moneses uniflora																					2
Parnassia palustris																					
Pedicularis labradorica																					
Penstemon procerus																					
Petasites palmatus																					
Petasites sagittatus	1		2							2				1						1	2
Petasites vitifolius																					
Potentilla palustris			3	3	2	3	2			2					2	3				2	2
Pyrola asarifolia																					
Pyrola minor												1	2	1	1						
Pyrola secunda																					
Pyrola virens																					
Ranunculus gmelinii																					
Ribes lacustre													3								
Ribes triste													2								
Rumex crispus																					
Rumex occidentalis			1							2		1	1								
Salix serissima																					
Scheuchzeria palustris																					
Scutellaria galericulata																					
Senecio pauciflorus																					
Sium suave																					
Smilacina trifolia	2	3	2	2	3		3	2	2	2	3	2	2	3	3	3	2	1	3	2	2
Spiranthes romanzoffiana																					
Stellaria calycantha																					

Species	14C ftnn	15A btnn	15B fons	16A fopn	17A ftnn	18A fong	19A ftnn	20A btnn	21A btnn	21B fons	22A btnn	23A ftnn	24A stnn	25A ftnn	26A ftnn	27A fons	28A ftnn	28B ftnn	28C btnn	29A ftnn	30A fons
Stellaria longifolia																2	2				2
Trientalis borealis																					
Triglochin maritima				2	1										1						
Triglochin palustris																					
Vicia americana																					
Viola palustris																					
Viola renifolia														1							
Agrostis scabra																					
Calamagrostis canadensis	3		3	1						3		3	3			3	2			2	3
Calamagrostis inexpansa																					
Carex aquatilis										3		3		3	3	3	3			3	3
Carex canescens			2							1						3	3				2
Carex chordorrhiza					2		1														
Carex diandra																				1	1
Carex disperma																					
Carex gynocrates						3						1			1						
Carex interior																					
Carex lasiocarpa																					
Carex leptalea																					
Carex limosa																					
Carex pauciflora	1		2				2			2					2	2	1				1
Carex prairea															3						
Carex rostrata			2	1		3															
Carex tenera										2											2
Carex trisperma																1	1				3
Deschampsia caespitosa																					
Eriogonum androsaceum										3											2
Eriophorum polystachion						2															
Eriophorum vaginatum		2	1		3						2					2					
Glyceria grandis																					
Glyceria striata																					
Phragmites australis																					
Scirpus pallidus																					
Typha latifolia																					
Amblystegium riparium			2	3	1																
Amblystegium serpens												1					1	1			
Aulacomnium palustre	2	1		3	2	2	2	2	2	2		2	2	2	2	3	2	3	2	2	3
Blephorostroma trichophyllum															1					1	
Bracythecium sp.	1						2					1	1	2			1	1	1	1	2
Bryum pseudotriquetrum	1					2							2	2							2
Calliergidium tundrae																					
Calliergon cordifolium	1																				
Calliergon giganteum															3						
Calliergon richardsonii																					1

Species	14C ftnn	15A btnn	15B fons	16A fopn	17A ftnn	18A fong	19A ftnn	20A btnn	21A btnn	21B fons	22A btnn	23A ftnn	24A stnn	25A ftnn	26A ftnn	27A fons	28A ftnn	28B ftnn	28C btnn	29A ftnn	30A fons
Calliergon stramineum										1					2	3	2				
Campylium chrysophyllum							2							2							
Campylium polygamum																					
Campylium radicale																					
Campylium stellatum						1															1
Cephalozia connivens																					
Cephalozia linulifolia																					
Cephalozia pleniceps																					
Cephalozia sp.		1							1					1						1	
Cephaloziella hampeana																					
Cephaloziella spinigera																					
Ceratodon purpureus	1				2		2											2	2	2	1
Climacium dendroides										1							1	2			1
Dicranum acutifolium																					
Dicranum elongatum																					
Dicranum fragilifolium																					
Dicranum fuscescens																					
Dicranum polysetum		1																1	1		
Dicranum undulatum	2	2		2	2			2	2		2	2	1	2	2		2		2	2	
Drepanocladus aduncus																	1				2
Drepanocladus exannulatus						3											2				
Drepanocladus fluitans							3			3					1				1		
Drepanocladus revolvens																					
Drepanocladus uncinatus								0.01						1	1		1	2	2	2	
Drepanocladus vernicosus				3	2	2									3						2
Eurhynchium pulchellum																					
Helodium blandowii				1						2			2	1			2	1		2	2
Hylocomium splendens	2			2								2	2	2		3	1	3	3	2	1
Hypnum pratense															1		2				2
Isopterygium pulchellum															1					1	
Jamesoniella autumnalis																					
Lepidozia reptans		1																1	1	1	
Leptobryum pyriforme																					
Lophocolea bidentata																					
Lophozia sp.																				1	
Marchantia ploymorpha																					
Meesia triquetra																					
Mylia anomala	2	2			1			3	3		2	2		2	2		2		1	2	
Myurella julacae																					
Paludella squarrosa															1						
Plagiochila porelloides																					
Plagiomnium cuspidatum																					
Plagiomnium ellipicum												1	3	2	1		2	2		1	2
Plagiothecium laetum																		2			

Species	14C ftnn	15A btnn	15B fons	16A fopn	17A ftnn	18A fong	19A ftnn	20A btnn	21A btnn	21B fons	22A btnn	23A ftnn	24A stnn	25A ftnn	26A ftnn	27A fons	28A ftnn	28B ftnn	28C btnn	29A ftnn	30A fons
Pleurozium schreberi	2	1						2	2		1	3	2	3	2	2	2	3	3	3	
Pohlia nutans	1	2			2			1	1	2	1	2	1		1	2	1	2	2	1	
Polytrichum commune																					
Polytrichum strictum	2			2	2		2	2	2	3	2	2	2	2	2	2	2		2	2	2
Ptilidium ciliare								1	2				1		1				1	2	
Ptilium crista-castrensis				1				1					2						2	1	
Pylaisiella polyantha																		2			
Rhizomnium gracile																					
Rhizomnium pseudopunctatum																					
Scorpidium scorpioides				3																	
Sphagnum angustifolium	3	2	2		3		3		1	3		2		2	3	1	2		2	3	3
Sphagnum centrale										1					2						
Sphagnum fuscum	2	3			3		2	3	3	2	3	3	2	3	2		3		3	3	2
Sphagnum jensenii																					
Sphagnum magellanicum	2	2			2		2			1		2			2		2			2	
Sphagnum nemoreum		2						1	2								1		2		
Sphagnum obtusum																					
Sphagnum riparium																					
Sphagnum russowii																					
Sphagnum squarrosum										1											
Sphagnum subsecundum																					
Sphagnum teres	2		1							2						3					
Sphagnum warnstorfii			2	2									2		2					1	3
Splachnum sphaericum																					
Tetraphis pellucida																					
Tetraplodon angustatus														1				1			
Thuidium recognitum												1	2					1			
Tomenthypnum falcifolium					1										2						
Tomenthypnum nitens	2		1	2	3	2	2			2		2	2	2	3	2	2	1		3	3
Cladina mitis		3			2		1	3	3		3	3	1	2	2	1	2	1	3	2	
Cladina rangiferina		0.01						2			2										
Cladina sp.																					
Cladina stellaris								1			1										
Icmadophila ericetorum		1						2	2		1				1						
Peltigera aphthosa																					1
Peltigera leucophlebia																					
Peltigera malacea																					
Peltigera neopolydactyla							2					2	2		2		2	1			
Lemna minor																					
Utricularia intermedia				3		3															
Utricularia vulgaris																					

Species	31A btnn	32A ftnn	33A btnn	34A btnn	35A btnn	36A ftnn	36B ftnn	37A fons	38A ftnn	39A ftnn	40A ftnn	41A btnn	42A fons	43A ftnn	44A btnn	45A fons	46A btnn	47A ftnn	48A fong	49A ftnn
Larix laricina		1							1					1						
Picea mariana																				
Alnus rugosa														2						
Betula papyrifera																				
Betula pumila																				
Larix laricina		3	1	2		2	2		2	2	2							2		3
Picea mariana	3		3	3	3	3			3	3	2	3			3		3	3		2
Pinus banksiana																				
Populus tremuloides																				
Salix bebbiana																				
Salix discolor																				
Salix exigua																				
Salix maccalliana														3						
Salix myrtillifolia						2														
Salix planifolia																				
Salix scouleriana																				
Alnus rugosa																				
Betula glandulosa						2														
Betula papyrifera								1			0.01			1						
Betula pumila							3	3			3					3				3
Larix laricina		3				3	3	2		3										
Picea mariana	3		3	3	3	3		2	3	3		3			3		3			
Pinus banksiana				1																
Populus balsamifera																				
Salix arbusculoides																				
Salix bebbiana																				
Salix candida																				
Salix discolor																				
Salix maccalliana													3							
Salix myrtillifolia				2					2											
Salix pedicellaris		3																		
Salix planifolia					2			3												
Salix pyrifolia																				
Salix serissima																				
Alnus crispa																				
Alnus rugosa																				
Andromeda polifolia		3				2	2													
Betula glandulosa				1													2			
Betula papyrifera				1																
Betula pumila		3							2	3	3							3	2	
Chamaedaphne calyculata											2	2			3				3	2
Empetrum nigrum			1		2					1										
Larix laricina								1												
Ledum groenlandicum	3	3	3	3	3	3			3	3	2	3			3		3	2		3

Species	31A btnn	32A ftnn	33A btnn	34A btnn	35A btnn	36A ftnn	36B ftnn	37A fons	38A ftnn	39A ftnn	40A ftni	41A btnn	42A fons	43A ftnn	44A btnn	45A fons	46A btnn	47A ftnn	48A fong	49A ftnn
Linnaea borealis																				
Lonicera involucrata					2															
Lonicera vilosa																				
Myrica gale								3								3				
Picea mariana														1						
Prunus virginiana																				
Ribes hudsonianum									0.01					1						
Ribes oxyacanthoides																				
Rosa acicularis																				
Rubus chamaemorus	3	2	2	3	2	3			2	3	1	3			3		3			
Rubus acaulis		3					2	2		2	2			3				3		
Rubus idaeus																				
Salix arbusculoides																				
Salix bebbiana						1														
Salix candida						1	2	1		1										2
Salix discolor																				
Salix exigua																				
Salix lucida																				
Salix maccalliana																				
Salix myrtillifolia		2								2								2		
Salix pedicellaris						2	2			2	3					3		2	3	3
Salix petiolaris																				
Salix planifolia																		3		
Salix pyrifolia											2									
Salix scouleriana																				
Salix serissima																				
Salix sp.																				
Vaccinium myrtilloides						1											3			
Vaccinium oxycoccus	2	2	2	2	1	2			2	2	3	3			2		3	3		2
Vaccinium uliginosum																				
Vaccinium vitis-idaea	3		3	3	2	3			3	3	2	3			3		3	2		3
Achillea millefolium																				
Aster ciliolatus																				
Aster puniceus																				
Astragalus americanus																				
Caltha palustris		1					1	2	1		2			3		2				2
Cicuta bulbifera																				
Cicuta maculata																				
Cornus canadesis																				
Cornus stolonifera																				
Drosera rotundifolia		1				0.01			2	3	0.01									
Epilobium angustifolium								1						1						
Epilobium ciliatum																				
Epilobium leptophyllum																				

Species	31A btnn	32A ftnn	33A btnn	34A btnn	35A btnn	36A ftnn	36B ftnn	37A fons	38A ftnn	39A ftnn	40A ftni	41A btnn	42A fons	43A ftnn	44A btnn	45A fons	46A btnn	47A ftnn	48A fong	49A ftnn
Epilobium palustre		1						1		1	1		2							2
Equisetum arvense																				
Equisetum fluviatile						2	2							3						
Equisetum pratense																				
Equisetum sylvaticum																				
Galium boreale																				
Galium labradoricum																				
Galium trifidum		2					2	3		3	1		3	2		3				2
Galium triflorum																				
Geocaulon lividum																				
Geum macrophyllum																				
Habenaria hyperborea								1												1
Hippuris vulgaris													2							
Impatiens capensis																				
Lycopodium annotinium																				
Lysimachia thyrsiflora								2		2				2						
Menyanthes trifoliata							3												3	3
Mitella nuda									1											1
Moneses uniflora		2						1												
Parnassia palustris																				
Pedicularis labradorica																		2		2
Penstemon procerus																				
Petasites palmatus																				
Petasites sagittatus														2						
Petasites vitifolius																				
Potentilla palustris		2				2	3	2		3	3		3	3		3				
Pyrola asarifolia											2									
Pyrola minor																				
Pyrola secunda														1						
Pyrola virens		1																		
Ranunculus gmelinii																				
Ribes lacustre																				
Ribes triste																				
Rumex crispus							2	2		2	2			2						
Rumex occidentalis		2																		
Salix serissima																				
Scheuchzeria palustris																			3	
Scutellaria galericulata																				
Senecio pauciflorus																				
Sium suave														1						
Smilacina trifolia	3	2	2	2		3		2	2	2	2			3	2	2				3
Spiranthes romanzoffiana																				0.01
Stellaria calycantha																				

Species	31A btnn	32A ftnn	33A btnn	34A btnn	35A btnn	36A ftnn	36B ftnn	37A fons	38A ftnn	39A ftnn	40A ftni	41A btnn	42A fons	43A ftnn	44A btnn	45A fons	46A btnn	47A ftnn	48A fong	49A ftnn
Stellaria longifolia		2						3			2		1	2		2				1
Trientalis borealis							2			1										
Triglochin maritima																				
Triglochin palustris																				
Vicia americana																				
Viola palustris																				
Viola renifolia																				
Agrostis scabra																				
Calamagrostis canadensis		3				2	2	2	2	3	3		3	3		2				2
Calamagrostis inexpansa																				
Carex aquatilis						2		3	3	3	3		3			3		3		3
Carex canescens								2			2								1	
Carex chordorrhiza																				
Carex diandra		1					2	3		3	1					2				2
Carex disperma						2		2	2	2	2									2
Carex gynocrates																				
Carex interior							2												2	
Carex lasiocarpa							3													
Carex leptalea									2							1				1
Carex limosa										2									3	
Carex pauciflora		2				2		1		1	3			2		1				1
Carex prairea																				
Carex rostrata											2		1			2				
Carex tenera		2				2				2	2					1				
Carex trisperma		2												2		2				
Deschampsia caespitosa																				
Eriogonum androsaceum							3			1										
Eriophorum polystachion																				
Eriophorum vaginatum	3	1		3		2		2			2	3			2		3		2	
Glyceria grandis																				
Glyceria striata																				
Phragmites australis																				
Scirpus pallidus													1							
Typha latifolia																3				
Amblystegium riparium			0.01			2														1
Amblystegium serpens		1		0.01										1						
Aulacomnium palustre	2	2	2	2	3	2	2	3	2	2	3	2		2	2	2		3		3
Blephorostroma trichophyllum						1			2											
Bracythecium sp.		1		0.01	1	2		3	1	2	2		3	2		3		2		2
Bryum pseudotriquetrum		2		0.01				3	2	2	2			1		3		3		2
Calliergidium tundrae														1		3				
Calliergon cordifolium										3				3						
Calliergon giganteum																		2		
Calliergon richardsonii							1													

Species	31A btnn	32A ftnn	33A btnn	34A btnn	35A btnn	36A ftnn	36B ftnn	37A fons	38A ftnn	39A ftnn	40A ftni	41A btnn	42A fons	43A ftnn	44A btnn	45A fons	46A btnn	47A ftnn	48A fong	49A ftnn
Calliergon stramineum																				3
Campylium chrysophyllum																				
Campylium polygamum																				
Campylium radicale									2				2							
Campylium stellatum																				
Cephalozia connivens																				
Cephalozia linulifolia																				
Cephalozia pleniceps									1			1								
Cephalozia sp.		1																		
Cephaloziella hampeana																				
Cephaloziella spinigera																1				
Ceratodon purpureus		1			2	2			2											
Climacium dendroides					0.01					1			1	1		2				
Dicranum acutifoilium																				
Dicranum elongatum														2						
Dicranum fragilifolium																				
Dicranum fuscescens										1										
Dicranum polysetum	2				2	2								1			2			2
Dicranum undulatum	2	2	1	2	2	2			2							3		1		
Drepanocladus aduncus						1	2	3	2	2	2							2		
Drepanocladus exannulatus																				
Drepanocladus fluitans	1	1																		
Drepanocladus revolvens																				
Drepanocladus uncinatus		1			2	2		3		2	2	2		2	2	2		2		
Drepanocladus vernicosus							3			1									3	3
Eurhynchium pulchellum																				
Helodium blandowii		2						2	2	2	3			3		3		1		3
Hylocomium splendens		1			2	2		1	2	1	1			2				2		2
Hypnum pratense		2					3	3	2		2			2		3		2		2
Isopterygium pulchellum														2						
Jamesoniella atumnalis																				
Lepidozia reptans			1			2			2			1						1		1
Leptobryum pyriforme									1									1		
Lophocolea bidentata																				
Lophozia sp.					1	1			2	1					1					
Marchantia ploymorpha									1		1					1				
Meesia triquetra							2													
Mylia anomala	2		2	2	1				1	2		2			2		2	1		
Myurella julacae																				
Paludella squarrosa														2						
Plagiochila porelloides														2				2		
Plagiomnium cuspidatum								3	0.01	3	3		1	3		2				3
Plagiomnium ellipicum	0.01	2						3				0.01		2	1					
Plagiothecium laetum																				

Species	31A btnn	32A ftnn	33A btnn	34A btnn	35A btnn	36A ftnn	36B ftnn	37A fons	38A ftnn	39A ftnn	40A ftni	41A btnn	42A fons	43A ftnn	44A btnn	45A fons	46A btnn	47A ftnn	48A fong	49A ftnn
Pleurozium schreberi	3		1	2	3	1			3	2		2		2	3		2	2		2
Pohlia nutans	1	1	2	1	2	2		3	2	2		2		2	2			1		1
Polytrichum commune																				
Polytrichum strictum	1	3	2	3	2	2		2	2	2	2	2			2		2	2		
Ptilidium ciliare	2	1	1	1	2	2			2	1					2					2
Ptilium crista-castrensis		1		1	2	0.01			2	1		1		2	1					1
Pylaisiella polyantha														2				1		
Rhizomnium gracile										1						3		1		
Rhizomnium pseudopunctatum																				
Scorpidium scorpiodes																				
Sphagnum angustifolium	2	3	1	1	2	3			2	2	3	2		2	2			2		2
Sphagnum centrale											2			2					2	
Sphagnum fuscum	3	2	3	3	3	3			3	3	2	3			3		3	2		2
Sphagnum jenseii																				
Sphagnum magellanicum	2	3	1		2	2			2		2	2			2					
Sphagnum nemoreum	2	1	2		2	2				2		2		2	1		1			
Sphagnum obtusum																				
Sphagnum riparium						1														
Sphagnum russowii						1				1	2			2						
Sphagnum squarrosum																				
Sphagnum subsecundum																				
Sphagnum teres														2						3
Sphagnum warnstorfii											1							2		1
Splachnum sphaericum										0.01										
Tetraphis pellucida																				
Tetraplodon angustatus																				
Thiudium recognitum								3								1				
Tomenthypnum falcifolium																				
Tomenthypnum nitens		3			1	2		2	3	3	3			1		2		3		3
Cladina mitis	3	2	3	3	2	2			2	2	0.01	3		1	3		3			
Cladina rangiferina	2										0.01						1			
Cladina sp.																				
Cladina stellaris	1																			
Icmadophila ericetorum	1		2	1	1				1			1			0.01		1			
Peltigera aphthosa																				
Peltigera leucophlebia											2			0.01		0.01		1		
Peltigera malacea																				
Peltigera neopolydactyla		1		0.01				0.01	1	0.01	1				1		0.01	1		
Lemna minor													1							
Utricularia intermedia							3			1						1				
Utricularia vulgaris																				

Species	50A stnn	51A btxn	52A btnn	53A fons	54A ftnn	55A btnn	56A fopn	57A ftnn	58A ftnn	59A ftnn	60A btnn	61A fong	62A ftnn	63A stnn	64A ftnn	65A btnn	65B fons	66A ftnn	67A ftnn	68A btnn	69A ftnn
Larix laricina	1									2									1		
Picea mariana		3						2											2		
Alnus rugosa	3						1														
Betula papyrifera	3						2						1								
Betula pumila																					
Larix laricina					2		1	2	2	3			2	3	2			3	2		3
Picea mariana			3		3	3		3	0.01		3		3	2	3	3			3	3	
Pinus banksiana					0.01										0.01						
Populus tremuloides																					
Salix bebbiana																					
Salix discolor																					
Salix exigua																					
Salix maccalliana								3													
Salix myrtillifolia																					
Salix planifolia																					
Salix scouleriana																			2		
Alnus rugosa																					
Betula glandulosa																					
Betula papyrifera																					
Betula pumila														0.01							
Larix laricina							2			3							3	3			3
Picea mariana			3		3	3					3	1			3	3	1	3			3
Pinus banksiana																		0.01	3	3	2
Populus balsamifera																					
Salix arbusculoides																					
Salix bebbiana																		0.01			
Salix candida							2						3								
Salix discolor																		2			
Salix maccalliana																					
Salix myrtillifolia																					
Salix pedicellaris																					
Salix planifolia					3																
Salix pyrifolia						0.01									2		3			2	
Salix serissima					2													1		1	
Alnus crispa																					
Alnus rugosa																					
Andromeda polifolia			3							2				3							
Betula glandulosa																		2			
Betula papyrifera																					
Betula pumila		0.01		3			3		3			2		3						1	
Chamaedaphne calyculata			3			3			2	2	3										
Empetrum nigrum								2													
Larix laricina																			3		
Ledum groenlandicum		2	3		3	3		3			3		3	2	3	3		0.01	3	3	2

Species	50A stnn	51A btxn	52A btnn	53A fons	54A ftnn	55A btnn	56A fopn	57A ftnn	58A ftnn	59A ftnn	60A btnn	61A fong	62A ftnn	63A stnn	64A ftnn	65A btnn	65B fons	66A ftnn	67A ftnn	68A btnn	69A ftnn
Linnaea borealis																					
Lonicera involucrata																					
Lonicera vilosa															0.01			0.01			
Myrica gale							2			3											
Picea mariana																					1
Prunus virginiana																	0.01				
Ribes hudsonianum	2				1																
Ribes oxyacanthoides																					
Rosa acicularis																					
Rubus chamaemorus		1	3		3	3		2			3		2		3	3			3	2	
Rubus acaulis				2	2		2	1	3			2	2	2			3	3	1		
Rubus idaeus	0.01																				
Salix arbusculoides																	1				
Salix bebbiana														0.01				1			
Salix candida																					
Salix discolor																					
Salix exigua																					
Salix lucida																					
Salix maccalliana													2								
Salix myrtillifolia								3	1				1	1	3						
Salix pedicellaris				3			2		3			3					3	2			2
Salix petiolaris																					
Salix planifolia																					
Salix pyrifolia																					
Salix scouleriana																					
Salix serissima					3																
Salix sp.																					
Vaccinium myrtilloides						0.01															
Vaccinium oxycoccus			3		3	3		3		3			1		3				3	1	3
Vaccinium uliginosum																					
Vaccinium vitis-idaea		2			3	3		2		2	3		2		3	3			3	3	2
Achillea millefolium								1													
Aster ciliolatus																					
Aster puniceus	0.01													1			1				
Astragalus americanus																					
Caltha palustris	2									2				3				1			2
Cicuta bulbifera				0.01																	0.01
Cicuta maculata	1																				
Cornus canadesis																					
Cornus stolonifera																					
Drosera rotundifolia												3									2
Epilobium angustifolium								1					0.01	1				1			1
Epilobium ciliatum																					
Epilobium leptophyllum																					

Species	50A stnn	51A btxn	52A btnn	53A fons	54A ftnn	55A btnn	56A fopn	57A ftnn	58A ftnn	59A ftnn	60A btnn	61A fong	62A ftnn	63A stnn	64A ftnn	65A btnn	65B fons	66A ftnn	67A ftnn	68A btnn	69A ftnn
Epilobium palustre	1			1			1										2	2			1
Equisetum arvense	3			3				3							2			2			
Equisetum fluviatile																					
Equisetum pratense													2	3					2		
Equisetum sylvaticum						1		3					3	3	3				3		
Galium boreale																					
Galium labradoricum	3			2			2			2				3			2	1			3
Galium trifidum														2							
Galium triflorum																					
Geocaulon lividum																					
Geum macrophyllum																					
Habenaria hyperborea																					
Hippuris vulgaris																					0.01
Impatiens capensis	1																				
Lycopodium annotinium																					
Lysimachia thyrsiflora																					
Menyanthes trifoliata														2			1	2			2
Mitella nuda					2			1					1	3				2			
Moneses uniflora																					
Parnassia palustris					2			1											1		
Pedicularis labradorica																					
Penstemon procerus					1			3	2					1	1			2			
Petasites palmatus	2							1													
Petasites sagittatus																					
Petasites vitifolius	3			3			3		1	1		3					3	2			2
Potentilla palustris					2			0.01					1		2						
Pyrola asarifolia										1				2							
Pyrola minor																			2		
Pyrola secunda														1			1	2			2
Pyrola virens														0.01							
Ranunculus gmelinii									1												
Ribes lacustre						2											1	2			
Ribes triste	1																				
Rumex crispus																					
Rumex occidentalis	2	2	3	2	3	2		2	3				1	3	2	3		3	2	2	3
Salix serissima														2							
Scheuchzeria palustris																					
Scutellaria galericulata																					
Senecio pauciflorus																					
Sium suave																					
Smilacina trifolia																					
Spiranthes romanzoffiana																					
Stellaria calycantha																					

Species	50A stnn	51A btxn	52A btnn	53A fons	54A ftnn	55A btnn	56A fopn	57A ftnn	58A ftnn	59A ftnn	60A btnn	61A fong	62A ftnn	63A stnn	64A ftnn	65A btnn	65B fons	66A ftnn	67A ftnn	68A btnn	69A ftnn
Stellaria longifolia				2					2	2							1	2			2
Trientalis borealis																					
Triglochin maritima				2								3									
Triglochin palustris																					
Vicia americana																					
Viola palustris	1																				
Viola renifolia																					
Agrostis scabra																					
Calamagrostis canadensis	3			2			3	2	3			2	2	2			2	2		2	2
Calamagrostis inexpansa																					
Carex aquatilis	2		2	3	2		3	3	3	3		3	2	2	3			3		2	2
Carex canescens		0.01							1												
Carex chordorrhiza																					
Carex diandra				2			2					2					3	2			2
Carex disperma		1						1													
Carex gynocrates				2				1	3			3									
Carex interior																		0.01			
Carex lasiocarpa																	3	2			
Carex leptalea														1							
Carex limosa				3								2									
Carex pauciflora		1		1						3								1			3
Carex prairea					2									1							
Carex rostrata	3											3					1	2			
Carex tenera				2					3								3	1			1
Carex trisperma					2									2			2	3	1		
Deschampsia caespitosa																					
Eriogonum androsaceum									2									1			
Eriophorum polystachion																					
Eriophorum vaginatum			3	2			2				2					3					1
Glyceria grandis																					
Glyceria striata														2							
Phragmites australis																					
Scirpus pallidus																					
Typha latifolia																					
Amblystegium riparium																					
Amblystegium serpens	3						1							1	1						
Aulacomnium palustre	1	2	2	2	2	2	2	2	2	2	2	3	2	3		2	3	3	2	2	2
Blephorostroma trichophyllum					0.01			2					2		1				2		
Bracythecium sp.	3	0.01		2	2		3	2	2				1	3	2		2	2	2		
Bryum pseudotriquetrum		0.01			1						0.01				1		2	3	1		2
Calliergidium tundrae																					
Calliergon cordifolium					2										1						2
Calliergon giganteum												3									2
Calliergon richardsonii									2	2											

Species	50A stnn	51A btxn	52A btnn	53A fons	54A ftnn	55A btnn	56A fopn	57A ftnn	58A ftnn	59A ftnn	60A btnn	61A fong	62A ftnn	63A stnn	64A ftnn	65A btnn	65B fons	66A ftnn	67A ftnn	68A btnn	69A ftnn
Calliergon stramineum				2																0.01	3
Campylium chrysophyllum														1							
Campylium polygamum																					
Campylium radicale																					
Campylium stellatum					1			2	1			1	2	1							
Cephalozia connivens																					
Cephalozia linulifolia																					
Cephalozia pleniceps																					
Cephalozia sp.											1					1				1	
Cephaloziella hampeana																					
Cephaloziella spinigera													1								
Ceratodon purpureus		2	1		2										1						
Climacium dendroides	2						1							2				1			
Dicranum acutifolium																					
Dicranum elongatum		2																			
Dicranum fragilifolium					1		1						1								
Dicranum fuscescens										1											
Dicranum polysetum		3														1				2	
Dicranum undulatum		2	2		2	2				2	2		2	2	2	2			2	2	
Drepanocladus aduncus	3				2			3	3					3			2	2	1		3
Drepanocladus exannulatus		1	0.01	2			3	3	2	2		2								0.01	
Drepanocladus fluitans														2							
Drepanocladus revolvens																					
Drepanocladus uncinatus					2			3	2				2		2	1		3	2		
Drepanocladus vernicosus				3					2			3					2				3
Eurhynchium pulchellum																					
Helodium blandowii				2	2		2	2	3				1	2			3	3			1
Hylocomium splendens		3			2			2	2				3	3	2	2		1	2	2	
Hypnum pratense					2			2	2			1	2	2				2			
Isopterygium pulchellum													1		1						
Jamesoniella atumnalis																					
Lepidozia reptans			1							1			1		1						
Leptobryum pyriforme								2													
Lophocolea bidentata																					
Lophozia sp.					2			1					1		1		1		1		
Marchantia ploymorpha																					
Meesia triquetra				2								3									
Mylia anomala			2		2	2		2		2	2					2			1	2	
Myurella julacae					0.01			0.01							1						
Paludella squarrosa																					
Plagiochila porelloides								2					2		2				1		
Plagiomnium cuspidatum	1																				
Plagiomnium ellipicum					2			2	0.01					3				1	2		2
Plagiothecium laetum			0.01	0.01				1							1						

Species	50A stnn	51A btxn	52A btnn	53A fons	54A ftnn	55A btnn	56A fopn	57A ftnn	58A ftnn	59A ftnn	60A btnn	61A fong	62A ftnn	63A stnn	64A ftnn	65A btnn	65B fons	66A ftnn	67A ftnn	68A btnn	69A ftnn
Pleurozium schreberi		3	2		3	2	1	2		2	2		3	3	3	3			3	3	1
Pohlia nutans		2	2	2	2					2	3		2	2	2	2			2	2	2
Polytrichum commune																					
Polytrichum strictum		1				2		2		2	2		2	3	2	2	1	2	2	2	2
Ptilidium ciliare		3	1		1					2	2		2			1			2	1	
Ptilium crista-castrensis		2	1		1			2			3		3	2	1	2			1	2	
Pylaisiella polyantha					1														2		
Rhizomnium gracile				2	1																
Rhizomnium pseudopunctatum	3			2					2				2								
Scorpidium scorpiodes																					
Sphagnum angustifolium		1	3	2		2				3	3					2			2	2	
Sphagnum centrale																					
Sphagnum fuscum			3		3	3		3		2	3		2		2	3			3	3	3
Sphagnum jenseii																					
Sphagnum magellanicum			3	2		2					3		1			2					2
Sphagnum nemoreum			1		2	2					3		1	2	2	2		3			
Sphagnum obtusum																					
Sphagnum riparium																					
Sphagnum russowii					2															2	
Sphagnum squarrosum				1								2						1			3
Sphagnum subsecundum																					
Sphagnum teres				3			1			1		1						2			3
Sphagnum warnstorfii													1					2			3
Splachnum sphaericum																					
Tetraphis pellucida																1					
Tetraplodon angustatus																					
Thiudium recognitum													1	3			1	1			
Tomenthypnum falcifolium																					
Tomenthypnum nitens					3			3	3			3	2	2	3		3	3	2	1	3
Cladina mitis		2			3	3		3		2	3		2		3	3			3	3	
Cladina rangiferina																					
Cladina sp.																					
Cladina stellaris																					
Icmadophila ericetorum						1									1						
Peltigera aphthosa																					
Peltigera leucophlebia		2			1			2	0.01						1		1		1		
Peltigera malacea																					
Peltigera neopolydactyla		1			2			1	1				1		2			2	1		
Lemna minor																					
Utricularia intermedia							3														
Utricularia vulgaris							3														

Species	70A ftnr	71A ftni	72A fons	73A btni	74A fong	75A btnn	76A ftni	77A fopn	78A ftnn	79A fons	80A btnn	81A btnn	82A ftni	83A ftnn	84A fons	85A stnn	86A ftni	87A ftnn	88A ftnn	88B fong	89A btnn	90A ftnn	91A ftnn
Larix laricina													2										
Picea mariana													2					1	3		1		
Alnus rugosa																							
Betula papyrifera	1						0.01			1						2							
Betula pumila																							
Larix laricina		3					2		2					3	2		1	2	2			3	3
Picea mariana	3	2		3		3	3		3		3	3	3	3		3	3	3	3		3	2	2
Pinus banksiana																							
Populus tremuloides																							
Salix bebbiana	1																						
Salix discolor																						1	
Salix exigua																							
Salix maccalliana																							
Salix myrtillifolia																							
Salix planifolia										3						3							
Salix scouleriana																							
Alnus rugosa																							1
Betula glandulosa																							
Betula papyrifera																							
Betula pumila								3											2			3	
Larix laricina															1								
Picea mariana				3		3					3	3					3				3		2
Pinus banksiana																							
Populus balsamifera																							
Salix arbusculoides																							
Salix bebbiana																	3						
Salix candida																							
Salix discolor																							
Salix maccalliana													3										1
Salix myrtillifolia																			2				
Salix pedicellaris													2										
Salix planifolia		1						2	2					3			2	3					
Salix pyrifolia																							
Salix serissima																						2	
Alnus crispa																							
Alnus rugosa																							
Andromeda polifolia		2	3	1		3			1			2			1								
Betula glandulosa																							
Betula papyrifera														3			0.01						
Betula pumila		3	3	2			3		3				3		3		2						3
Chamaedaphne calyculata		2		2		3	3				2	3									2		
Empetrum nigrum											1			3			1						
Larix laricina																							
Ledum groenlandicum	3	2		3		3	3		3		3	3	3	3		2	3	3			3	3	3

Species	70A ftnr	71A ftni	72A fons	73A btni	74A fong	75A btnn	76A ftni	77A fopn	78A ftnn	79A fons	80A btnn	81A btnn	82A ftni	83A ftnn	84A fons	85A stnn	86A ftni	87A ftnn	88A ftnn	88B fong	89A btnn	90A ftnn	91A ftnn
Linnaea borealis																3	1						
Lonicera involucrata								2						3					1				
Lonicera vilosa										0.01						1							
Myrica gale										1			1			1	1	1	1				
Picea mariana																		0.01					
Prunus virginiana																0.01							
Ribes hudsonianum											3	3	3	3			2	2	3		3		
Ribes oxyacanthoides								2	2	2			2				2	1					2
Rosa acicularis																1							
Rubus chamaemorus										1							3						
Rubus acaulis								1	2					1	0.01								
Rubus idaeus																							2
Salix arbusculoides																							1
Salix bebbiana																							
Salix candida																							
Salix discolor																							
Salix exigua																							
Salix lucida																							
Salix maccalliana																							
Salix myrtillifolia																							
Salix pedicellaris																							
Salix petiolaris																							
Salix planifolia																							
Salix pyrifolia																							
Salix scouleriana																							
Salix serissima																							
Salix sp.																							
Vaccinium myrtilloides																							
Vaccinium oxycoccus																							
Vaccinium uliginosum																							
Vaccinium vitis-idaea																							
Achillea millefolium																							
Aster ciliolatus																							
Aster puniceus																							
Astragalus americanus																							
Caltha palustris																							
Cicuta bulbifera																							
Cicuta maculata																							
Cornus canadesis																							
Cornus stolonifera																							
Drosera rotundifolia																							
Epilobium angustifolium																							
Epilobium ciliatum																							
Epilobium leptophyllum																							

Species	70A ftnr	71A ftni	72A fons	73A btni	74A fong	75A btnn	76A ftni	77A fopn	78A ftnn	79A fons	80A btnn	81A btnn	82A ftni	83A ftnn	84A fons	85A stnn	86A ftni	87A ftnn	88A ftnn	88B fong	89A btnn	90A ftnn	91A ftnn
Epilobium palustre		1	2		1		1		1					2						2			
Equisetum arvense																							
Equisetum fluviatile																							
Equisetum pratense										1						3		3	2				
Equisetum sylvaticum											2							3	1				
Galium boreale																1							
Galium labradoricum																				2			
Galium trifidum		1	2		2			2	3	2										2		2	1
Galium triflorum																1							
Geocaulon lividum																							
Geum macrophyllum																							
Habenaria hyperborea														0.01	2		0.01						
Hippuris vulgaris	1																						
Impatiens capensis																							
Lycopodium annotinium	1																						
Lysimachia thyrsiflora			1					2															0.01
Menyanthes trifoliata		2	3												3							3	
Mitella nuda										2						2	1	1	2				
Moneses uniflora																							
Parnassia palustris																2							
Pedicularis labradorica														1									
Penstemon procerus																							
Petasites palmatus																2							
Petasites sagittatus																1							
Petasites vitifolius																							
Potentilla palustris		3	1	1	3		2	3	2	3			3	2	3		2			3		3	3
Pyrola asarifolia																							
Pyrola minor													2										
Pyrola secunda									1	2				1		3	2		1			2	
Pyrola virens		1																					
Ranunculus gmelinii													1										
Ribes lacustre										1													
Ribes triste																							
Rumex crispus			1					1															
Rumex occidentalis										1												2	2
Salix serissima																							
Scheuchzeria palustris								1															
Scutellaria galericulata																							
Senecio pauciflorus																2							
Sium suave																							
Smilacina trifolia	2	3		3		3	3		3	2	3	3	3	2		2	2	2	2			3	2
Spiranthes romanzoffiana													1		0.01	2							
Stellaria calycantha																							

Species	70A ftnr	71A ftni	72A fons	73A btni	74A fong	75A btnn	76A ftni	77A fopn	78A ftnn	79A fons	80A btnn	81A btnn	82A ftni	83A ftnn	84A fons	85A stnn	86A ftni	87A ftnn	88A ftnn	88B fong	89A btnn	90A ftnn	91A ftnn
Stellaria longifolia		1			2				2	2			3		1							2	0.01
Trientalis borealis																							
Triglochin maritima			3												3								
Triglochin palustris																							2
Vicia americana																2							
Viola palustris																							
Viola renifolia										1													
Agrostis scabra			1																				1
Calamagrostis canadensis	2						3	2	2	3			2	2		2	2						
Calamagrostis inexpansa					1																	2	2
Carex aquatilis		3		2	3		3	3	3	3			3	3	3		2	3	2	3		3	3
Carex canescens				1			2			2			2										
Carex chordorrhiza																							
Carex diandra			3		3				2				2		3		2			2		2	1
Carex disperma									1	2						2							
Carex gynocrates			2				3						1		2							1	
Carex interior																							
Carex lasiocarpa																							
Carex leptalea																							
Carex limosa		1		2											3					2			
Carex pauciflora		2					2		2				2	2	2	1						2	3
Carex prairea																							
Carex rostrata																							
Carex tenera		1					2		2				3	1		1							
Carex trisperma								2		2			3	2					1			3	
Deschampsia caespitosa							1																
Eriogonum androsaceum			2				3								3								
Eriophorum polystachion																							
Eriophorum vaginatum		2		3		2	1				3	3	2						1				1
Glyceria grandis										2													
Glyceria striata																							
Phragmites australis																						2	
Scirpus pallidus																							
Typha latifolia																							1
Amblystegium riparium																							
Amblystegium serpens	1									2													2
Aulacomnium palustre	2	3	2	1	1	1	3	3	2	3	1	2	3	2	3	2	3	2	2		1	3	3
Blephorostroma trichophyllum													1										
Bracythecium sp.	1		1		1			3	2	3				2				2		2			
Bryum pseudotriquetrum			2		1		2	2	2	2						2					0.01		
Calliergidium tundrae																				1			
Calliergon cordifolium			2		2			3	3	3				3									
Calliergon giganteum					3			2												2			
Calliergon richardsonii									2				1							2			

Species	70A ftnr	71A ftni	72A fons	73A btni	74A fong	75A btnn	76A ftni	77A fopn	78A ftnn	79A fons	80A btnn	81A btnn	82A ftni	83A ftnn	84A fons	85A stnn	86A ftni	87A ftnn	88A ftnn	88B fong	89A btnn	90A ftnn	91A ftnn
Calliergon stramineum		2		1			3	2	1				2							3			2
Campylium chrysophyllum																		2					2
Campylium polygamum																							
Campylium radicale																							
Campylium stellatum	1									1						1		1					
Cephalozia connivens																							
Cephalozia linulifolia																							
Cephalozia pleniceps																							
Cephalozia sp.				1			1						1										
Cephaloziella hampeana																							
Cephaloziella spinigera																							
Ceratodon purpureus						2				2		1										2	3
Climacium dendroides								2		2													2
Dicranum acutifolium																							
Dicranum elongatum																							
Dicranum fragilifolium										1													
Dicranum fuscescens																		1					
Dicranum polysetum	1			1		2						1						1	2		3		
Dicranum undulatum	2	2		2		2	2		2		2	2	2	1			2	2	2		2		
Drepanocladus aduncus			1		2					1										3		1	2
Drepanocladus exannulatus	1	2					3						2							3			
Drepanocladus fluitans																							2
Drepanocladus revolvens			1							2													
Drepanocladus uncinatus	1	2					2	3	2				1	1		1							
Drepanocladus vernicosus			3				2		2						3								
Eurhynchium pulchellum																		3					
Helodium blandowii	1	2	3		2			2	1	1			1	2			1					2	1
Hylocomium splendens	3	2					1		2				2	2		2	2	2	2		2		1
Hypnum pratense									1					2		2							2
Isopterygium pulchellum																							
Jamesoniella atumnalis																		2					
Lepidozia reptans												1		1				1					
Leptobryum pyriforme										1			1					1					1
Lophocolea bidentata																							
Lophozia sp.		1					2					1	1	1									1
Marchantia ploymorpha																							
Meesia triquetra															3								
Mylia anomala	1			2		2			1		3	2	2				2	1			2		
Myurella julacae																							
Paludella squarrosa																							
Plagiochila porelloides							3																
Plagiomnium cuspidatum										2													
Plagiomnium ellipicum					1			2	2	3				2				3	2				2
Plagiothecium laetum		1																					

Species	70A ftnr	71A ftni	72A fons	73A btni	74A fong	75A btnn	76A ftni	77A fopn	78A ftnn	79A fons	80A btnn	81A btnn	82A ftni	83A ftnn	84A fons	85A stnn	86A ftni	87A ftnn	88A ftnn	88B fong	89A btnn	90A ftnn	91A ftnn
Pleurozium schreberi	3	1		2		2	2	2	2		2	1	2	3			3	3	3		3		
Pohlia nutans	2	3		1		3	2				1	3	2	1		2		2	2		2	2	2
Polytrichum commune							1																
Polytrichum strictum	3			2		2	2		2			1	2				2	2	2			3	2
Ptilidium ciliare	2					2	2						2					3	3		2		
Ptilium crista-castrensis	2	1					1		1		1		2	2		1	1	1	3				1
Pylaisiella polyantha							1											2					
Rhizomnium gracile																							
Rhizomnium pseudopunctatum									1							2		2	2				
Scorpidium scorpioides																							
Sphagnum angustifolium	1	2		2		2	3		3		1	3	3				2	1	2	2	2	2	3
Sphagnum centrale																							
Sphagnum fuscum	2	2		3		3	2		3		3	3	2	3			3	3	1		3	2	1
Sphagnum jensenii																							
Sphagnum magellanicum	0.01	2		1		3	3					3	1								3	1	1
Sphagnum nemoreum	1	3		2					2		2					3					2	2	
Sphagnum obtusum							3																
Sphagnum riparium	1						2																
Sphagnum russowii				1							1								2				
Sphagnum squarrosum	1	2					3	2	3				1	3	3					1			2
Sphagnum subsecundum																							
Sphagnum teres	1	2	1					1	3	2			3		3					1		1	1
Sphagnum warnstorfii							2								2								2
Splachnum sphaericum																							
Tetraphis pellucida																							
Tetraplodon angustatus																							
Thuidium recognitum										1						1							
Tomenthypnum falcifolium																							
Tomenthypnum nitens	0.01	2	3				1	2	2	1				2	3	3	1	2				3	2
Cladina mitis	2	1		3		3					3	1	2	2			3	2	3		3		2
Cladina rangiferina												1							1				
Cladina sp.																							
Cladina stellaris																			1				
Icmadophila ericetorum				2		1					2						1						
Peltigera aphthosa																							
Peltigera leucophlebia	1									2			2	1		2		3	2				1
Peltigera malacea																							
Peltigera neopolydactyla							2						2	1		2	2	2	1			1	2
Lemna minor																							1
Utricularia intermedia			3																	2			
Utricularia vulgaris								1															

APPENDIX 4

RECOMMENDED CODING FOR ALBERTA WETLAND STANDARDS INVENTORY

CODING EXPLANATION FOR WETLAND POLYGONS

Refer to Table 4-1 for AWI (AVI) database structure and allowable codes and to Table 4-2 for sample field data recording sheet.

Locational Data – Columns 1 to 19

Column 1 - 10	AWI (AVI) Polygon Number is the unique identification of each polygon; numeric, up to ten digits, e.g. 0000000001 – 9999999999. This unique identifier permits retrieval of locational (ATS) and other information from the AWI (AVI attribute database.
Column 11 – 20	Aerial Photography – Roll Number, e.g. AS4265, GAS4376.
Column 21 - 23	Photo Number, e.g. 167.

Primary, Secondary, Tertiary Wetland Components – Columns 20 - 35

Column 24, 25, 30, 35	Decile: One of two digits from 1 to 10 describing the percentage of the polygon represented by each wetland component. Only the Primary component may have up to two digits (100%). The Secondary component may represent between 20% and 50% of the polygon and may be equal to but not greater than the percentage of the Primary component. The Tertiary component may represent no more that 20% of the polygon. In cases where the proportion of the Primary is 80% and the next component is 20% or more, the Primary and Secondary fields are coded, not the Tertiary fields. Where the next component is 20% or less, the Primary and Tertiary fields are coded. Up to three components are allowed because AVI polygons with "w" or "a" moisture regimes of "F" or "U" timber productivity ratings (TPR) often contain more than one wetland component significant for wetland management.

Column 26, 31, 36	Wetland Class: Refer also to Table 1 in body of report for definitions and allowable codes. Note that "Z" replaces "MINL" in Vitt et al. 1996 and is used alone for Non-wetland areas.
Column 27, 32, 37	Vegetation Modifier. Refer to Table 4-1 in standards for definitions and allowable codes. The class ranges correspond to groupings in the AVI Crown Closure Classes
Column 28, 33, 38	Wetland Complex Landform Modifier: Refer to Table 1 in standards for definitions and allowable codes.
Column 29, 34, 39	Local Landform Modifier: Refer to Table 1 in standards for definitions and allowable codes.

Other Data – Columns 36 - 70

Column 40	Reliability: Is a character code that indicates the level of confidence in delineating and/or designating the wetland components based on terrain complexity and the mapper's level of expertise. Reliability is coded as H (High), M (Medium), or L (Low).
Column 41	Data Sources: Inidcates how the information has been gathered in order to determine wetland polygon units. Data source is coded using a one character code as follows: E Full plots have been recorded for polygon units using the Eological Site description forms. N Site visit to the polygon unit, either drive or walk through with field notes. O Air observation. P Air photo interpretation.

Column 42 - 43	Interpreter: Interpreter's initials.
Column 44 - 60	Comments: Free format remarks regarding any of the above codings, or observations on conservation or management considerations.

TABLE 4-1: Alberta Wetland Inventory – Version 2.0 – Attribute Data Structure

Record Name	No. Byte	Field Type	Field Position	Allowable Codes
AWI (AVI) Polygon Number	**10**	**C**	**1 to 10**	**1-9999999999**
Aerial Photography – Roll Number	10	C	11 to 20	(AS, WL, etc.) 0001-9999
Aerial Photography – Photo Number	**3**	**C**	**21 to 23**	**001 - 9999**
WETLAND COMPONENT - PRIMARY				
Decile (≥ 40%)	**2**	**N**	**24 to 25**	**4, 5, 6, 7, 8, 9, 10**
Wetland Class	1	C	26	B, F, S, M, W, Z
Vegetation Modifier	**1**	**C**	**27**	**F, T, O**
Wetland Complex Landform Modifier	1	C	28	X, P, N
Local Landform Modifier	**1**	**C**	**29**	**C, R, I, N, S, G**
WETLAND COMPONENT – SECONDARY				
Decile (20 - 50%)	**2**	**N**	**30**	**2, 3, 4, 5**
Wetland Class	1	C	31	B, F, S, M, W, Z
Vegetation Modifier	**1**	**C**	**32**	**F, T, O**
Wetland Complex Landform Modifier	1	C	33	X, P, N
Local Landform Modifier	**1**	**C**	**34**	**C, R, I, N, S, G**
WETLAND COMPONENT – TERTIARY				
Decile (≤ 20%)	**2**	**N**	**35**	**1, 2**
Wetland Class	1	C	36	B, F, S, M, W, Z
Vegetation Modifier	**1**	**C**	**37**	**F, T, O**
Wetland Complex Landform Modifier	1	C	38	X, P, N
Local Landform Modifier	**1**	**C**	**39**	**C, R, I, N, S, G**
RELIABILITY	1	C	40	H, M, L
DATA SOURCE	**1**	**C**	**41**	**E, N, O, P**
Interpreter's Initials	2	C	42 to 43	
COMMENTS	**21**	**C**	**44 to 60**	**Free format**

Column 42 - 43	Interpreter: Interpreter's initials.
Column 44 - 60	Comments: Free format remarks regarding any of the above codings, or observations on conservation or management considerations.

TABLE 4-1: Alberta Wetland Inventory – Version 2.0 – Attribute Data Structure

Record Name	No. Byte	Field Type	Field Position	Allowable Codes
AWI (AVI) Polygon Number	10	C	1 to 10	1-9999999999
Aerial Photography – Roll Number	10	C	11 to 20	(AS, WL, etc.) 0001-9999
Aerial Photography – Photo Number	3	C	21 to 23	001 - 9999
WETLAND COMPONENT - PRIMARY				
Decile (≥ 40%)	2	N	24 to 25	4, 5, 6, 7, 8, 9, 10
Wetland Class	1	C	26	B, F, S, M, W, Z
Vegetation Modifier	1	C	27	F, T, O
Wetland Complex Landform Modifier	1	C	28	X, P, N
Local Landform Modifier	1	C	29	C, R, I, N, S, G
WETLAND COMPONENT – SECONDARY				
Decile (20 - 50%)	2	N	30	2, 3, 4, 5
Wetland Class	1	C	31	B, F, S, M, W, Z
Vegetation Modifier	1	C	32	F, T, O
Wetland Complex Landform Modifier	1	C	33	X, P, N
Local Landform Modifier	1	C	34	C, R, I, N, S, G
WETLAND COMPONENT – TERTIARY				
Decile (≤ 20%)	2	N	35	1, 2
Wetland Class	1	C	36	B, F, S, M, W, Z
Vegetation Modifier	1	C	37	F, T, O
Wetland Complex Landform Modifier	1	C	38	X, P, N
Local Landform Modifier	1	C	39	C, R, I, N, S, G
RELIABILITY	1	C	40	H, M, L
DATA SOURCE	1	C	41	E, N, O, P
Interpreter's Initials	2	C	42 to 43	
COMMENTS	21	C	44 to 60	Free format

TABLE 4-2: Field data coding sheet.

| AWI (AVI) POLYGON NUMBER | AERIAL PHOTOGRAPHY | | WETLAND COMPONENTS | | |